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Development Programme. Annual report
Vol: 1989 No: 1990 Date: 910300

TJ 163.25.C3 A56 20487147
ODFF EXC 1

1990 ANNUAL REPORT

ENERGY PROGRAM • PROGRAMME ENERGETIQUES

1989-1990 ANNUAL REPORT 1989-1990 RAPPORT ANNUEL

91-04635/

ENERGY RESEARCH & DEVELOPMENT PROGRAM PROGRAMME RECHERCHE ET DÉVELOPPEMENT ÉNERGÉTIQUES

OFFICE OF THE SCIENCE ADVISOR
ENVIRONMENT CANADA
MARCH 1991

BUREAU DU CONSEILLER SCIENTIFIQUE
ENVIRONNEMENT CANADA
MARS 1991

Acknowledgements:

This report has been prepared by the Office of the Science Advisor, Environment Canada. We wish to thank the Atmospheric Environment Service (AES) and Conservation and Protection (C&P) for providing the information upon which this report is based. The publication is printed on recycled paper using vegetable-based inks. Please think recycling!

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Remerciements

Le présent rapport a été rédigé par le Bureau du conseiller scientifique d'Environnement Canada. Nous tenons à remercier le Service de l'environnement atmosphérique (SEA) ainsi que Conservation et Protection (C&P) d'avoir fourni les renseignements essentiels. La publication est imprimée à l'encre végétale sur papier recyclé. Veuillez penser à recycler!

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EXECUTIVE SUMMARY

Energy R&D Program

Environment Canada is a prominent participant in the Federal Energy Research and Development Program. Together with participating government agencies on the Interdepartmental Panel on Energy Research and Development (PERD) and other contributors such as industry or provincial agencies, Environment Canada promotes research in the areas of pollution control, waste management and human health and safety. While priority is placed on direct environmental concerns, Environment Canada, through PERD, also plays a role in ensuring environmentally-sound energy development, such as alternative transportation fuels, and renewable energy sources.

This report provides an overview of Environment Canada's Energy Research and Development Program as it relates to PERD. It highlights research projects directly associated with Panel resources, but does not cover energy-environment programs which are solely funded through Environment Canada's A-Base resources.

Financial and Person-Year Disbursement

In 1989-90, the total PERD resources allocated to all participating Departments amounted to $90.1 M and 202 PYs. Environment Canada's portion amounted to just over $ 7.1 M and 15 PYs. In addition to the Energy R&D Program expenditures, Environment Canada's contribution from A-Base budgets amounted to $ 6.3 M and 41 PYs. The assistance of provincial research institutions, the private sector, universities and international institutions amounted to $ 6.0 M and an estimated 1 PY. The total expenditures associated with Environment Canada's Energy R&D Program totalled approximately $19.5 M and 57 PYs. The reduction of support from other funding sources is due to the number of projects that were either starting or being completed. Of the 52 projects undertaken in 1989-90, 40% where either initiated or completed.

In fiscal year 1989-90, responsibility for the administration of Environment Canada's Energy R&D Program was transferred from the Corporate Policy Group to the Office of the Science Advisor (OSA).

INTRODUCTION

In September 1988, the Government of Canada reconfirmed its commitment to the Federal Energy R&D Program. This decision meant that the Program received approval for a further four years (FY 1989-90 to 1991-92, with notional approval for FY 1992-93) with some shifts in technical emphasis from fossil fuels to energy efficiency, alternative energy sources and the environmental effects of energy supply and use. The Program's shift was also compatible with international events, particularly the direction announced by the International Energy Agency (IEA), of which Canada is a member.

These and other events had a bearing on the direction of the PERD objective which was re-iterated in a new way to reflect the need for the global commons to address issues affecting the long term future of the world's natural resources. The Program objective was subsequently redefined in 1989 with the focus of:

> *providing the science and technology for a diversified, economically and environmentally sustainable energy economy.*[1]

As is stated in the Program Plan, the PERD is one element in the total Canadian investment in energy technology. It is a crucial program which covers areas which the private sector cannot be expected to support alone.

> *Without the technical information provided by the Program, the Government would be vulnerable when making energy related decisions with environmental and public health and safety implications. This applies particularly to energy efficiency measures, coal, alternative transportation fuels and frontier oil and gas development.*[2]

Program Delivery

The Federal Energy R&D Program is uniquely interdepartmental. Environment Canada plays a significant role and receives approximately 8% of the total funding from the program (Figure 1). The ADM-level Panel, of which Environment Canada is a member, is charged with the overall management and co-ordination and delivery of the Energy R&D Program. In this capacity, the Panel is responsible for advising Treasury Board on the allocation of funds for energy R&D. The Panel:

> *coordinates energy R&D activities in the federal government, including the federal approach to major international and federal-provincial initiatives; follows the course of the government's environmental agenda and tailors the Program accordingly; and provides for the exchange of information on energy policy and strategies which would affect the direction of federal energy R&D programs.*
>
> *The Panel provides a forum for interdepartmental discussion and cooperation, making it responsive to a variety of government objectives. The Office of Energy R&D (OERD) in EMR is the secretariat to the Panel.*[3]

---

1 1989 Guide to the activities of the Panel on Energy Research and Development of the Government of Canada, Office of Energy Research and Development (OERD), EMR, 1989.

2,3 Plan of the Energy Research and Development Program of the Interdepartmental Panel on Energy Research and Development of the Government of Canada, OERD, EMR, 1990.

Figure 1 DISTRIBUTION OF 1989-90 FUNDS BY DEPARTMENT ENERGY R&D FUNDS OF THE PANEL ON ENERGY R&D ($ MILLION, 1989-90 $)

Departments:

Agr	Agriculture Canada
AECL	Atomic Energy of Canada Ltd.
CMHC	Canada Mortgage and Housing Co.
EC	Environment Canada
EMR	Energy, Mines and Resources
F&O	Fisheries and Oceans
ForCan	Forestry Canada
HWC	Health and Welfare Canada
INAC	Indian and Northern Affairs Canada
ND	National Defence
PWC	Public Works Canada
TC	Transport Canada

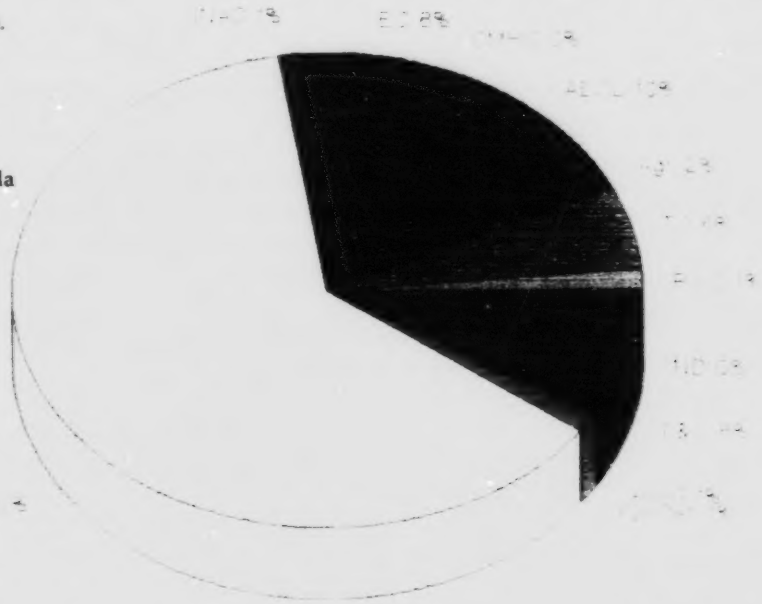
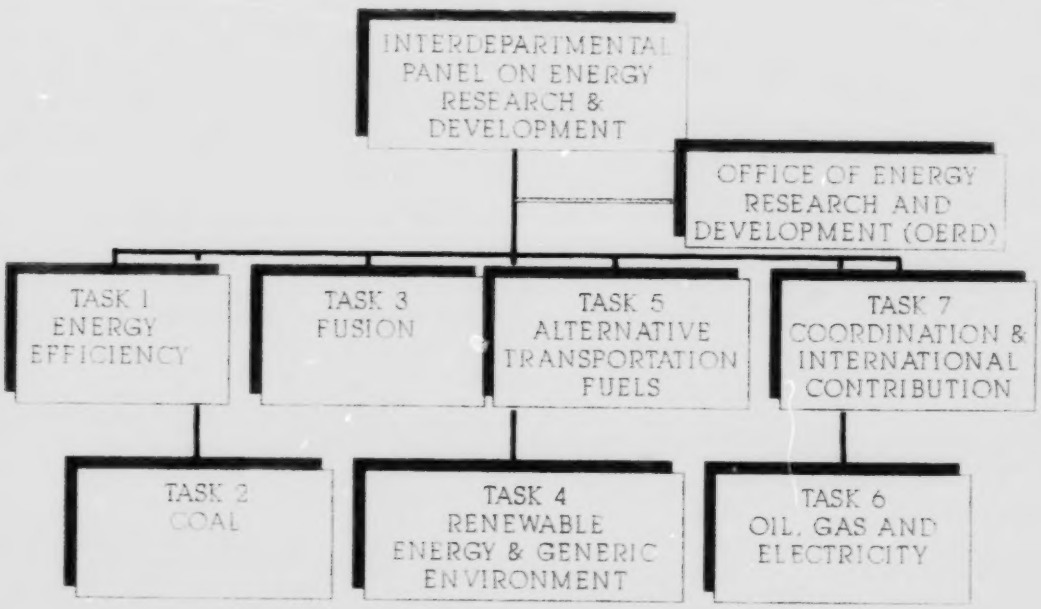


Figure 2 FEDERAL ENERGY R&D COORDINATING STRUCTURE


INTERDEPARTMENTAL PANEL ON ENERGY RESEARCH & DEVELOPMENT
OFFICE OF ENERGY RESEARCH AND DEVELOPMENT (OERD)
TASK 1 ENERGY EFFICIENCY
TASK 3 FUSION
TASK 5 ALTERNATIVE TRANSPORTATION FUELS
TASK 7 COORDINATION & INTERNATIONAL CONTRIBUTION
TASK 2 COAL
TASK 4 RENEWABLE ENERGY & GENERIC ENVIRONMENT
TASK 6 OIL, GAS AND ELECTRICITY

Program Tasks

The Energy R&D Program is organized into seven broad areas called "Tasks" (Figure 2). They are:

Task 1 - Energy Efficiency
Task 2 - Coal
Task 3 - Fusion
Task 4 - Renewable Energy and Generic Environment
Task 5 - Alternative Transportation Fuels
Task 6 - Oil, Gas, and Electricity
Task 7 - Co-ordination and International Participation

Figure 3 illustrates the distribution of departmental PERD resources as spent by the partners in the Program. Figure 4 illustrates the increase over the years of Environment Canada participation and partnership with industry. Environment Canada is an active player in all of the Tasks with the exception of Tasks 3 and 7. Figure 5 shows the distribution of departmental funds between the various PERD Tasks. Complete details on the disbursement of the resources are provided by Task in Table 1.

PERD resources in Environment Canada are used to augment existing research budgets in order to accelerate and co-ordinate the Department's response to federal energy-environment policy objectives. Program delivery is also designed to be compatible with the Government's Decision Framework for Science and Technology. Approximately 57% of the Environmental Canada's Energy R&D program is contracted to a variety of industries, utilities, provincial research organizations and universities across Canada.

Leverage is also a critical component of Environment Canada's efforts in the Program. About $6 million was levered by the Program in 1989-90. Major partners included: the Canadian Petroleum Association, the Coal Association of Canada, Les Industries Fournier, Superwood Ontario, International Pigments and Colours, United States Environmental Protection Agency, Ontario's Department of the Environment, International Energy Agency, Environmental Research Advisory Council, Office of Naval Research, and the U.S. National Science Foundation, to name a few.

Program Evaluation and Review

Energy R&D projects are developed in concert with A-Base projects and are subject to the same rigorous review. Annual line management project reviews involve consultation within the Department and with other government departments and the private sector for relevance and peer review for technical merit and performance. The annual department-wide review of research priorities takes account of advice to Ministers from review committees of the private and academic sectors and provincial governments. Energy R&D is assessed as a component of the Department's annual science and technology activities. The Department's Energy R&D Program is also reviewed annually to ensure consistency with other Federal R&D programs.

Environment Canada provide expertise to PERD on an ongoing basis by:

1) characterizing pollutants from the production and use of energy resources;
2) developing ways in which to reduce emissions, effluents and solid waste;
3) developing codes of practice and guidelines for environmental protection; and
4) assessing environmental conditions such as hydrology, meteorology and renewable energy sources.

Figure 3 1989-90 RESOURCES AS SPENT BY PARTNERS IN THE PROGRAM

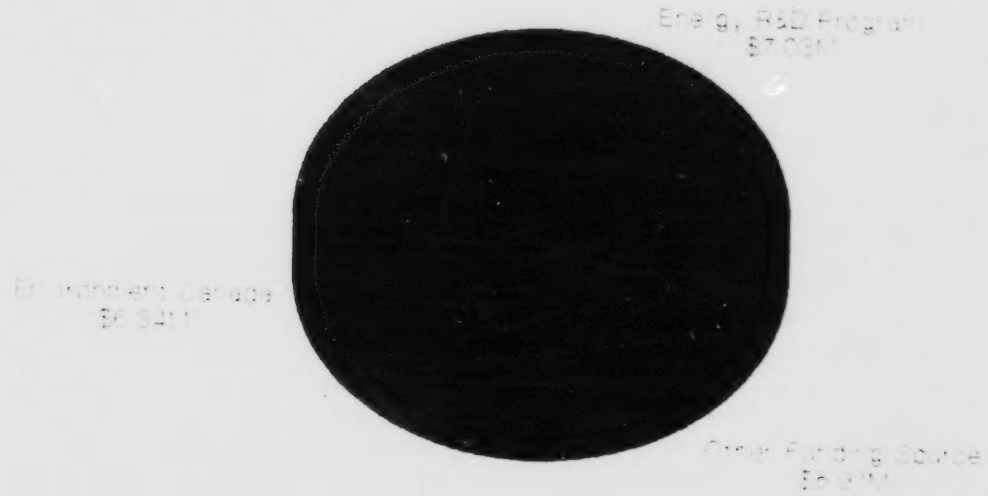


Figure 4 RESOURCES DISTRIBUTION OVER THE YEARS OF ENVIRONMENT CANADA'S PARTICIPATION AND PARTNERSHIP WITH INDUSTRY

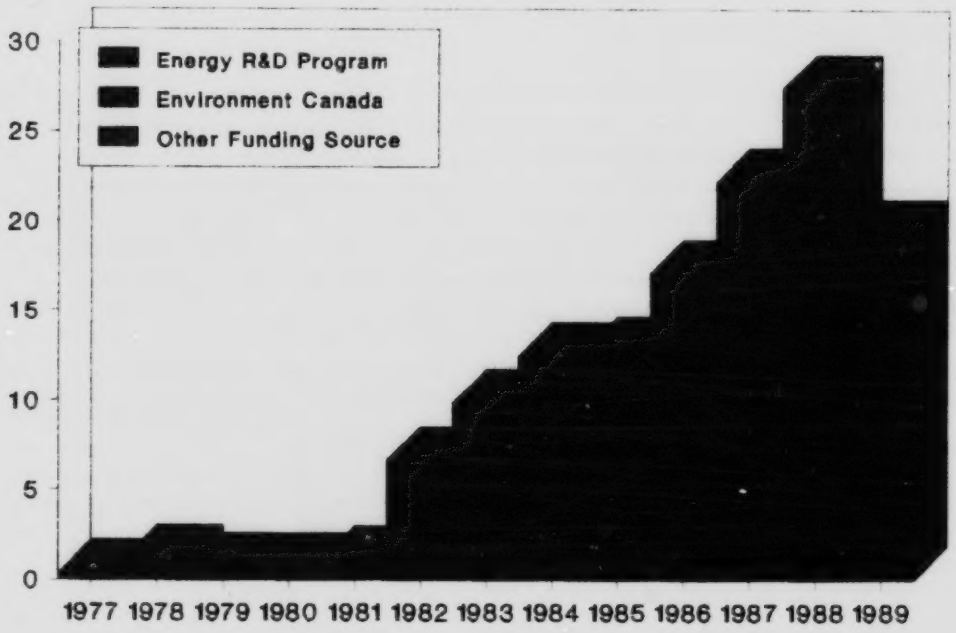
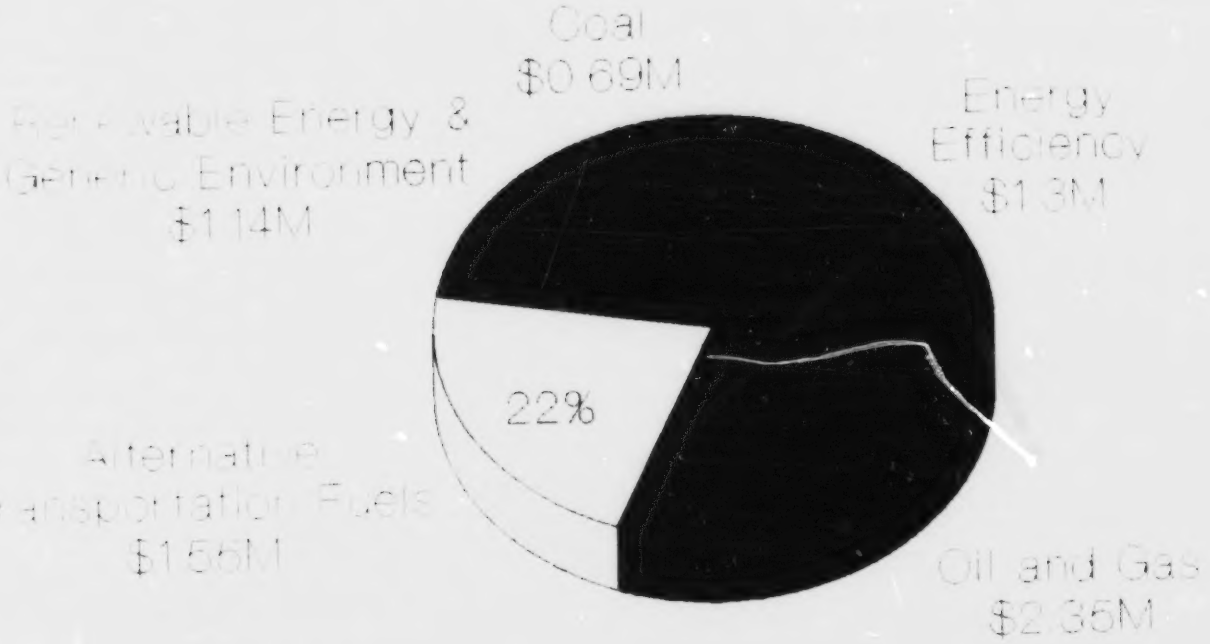


Table 1: Detailed Disbursement of Resources by Tasks

Energy R&D Program PERD All Tasks Expenditure Summary																				
Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)																
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
Task 1	Energy Efficiency	1,379	2.0	1,032	146	0	112	2.0	1,290	991	70	0	253	4.5	1,314	0.3	2,349	6.8	4,953
Task 2	Coal	668	1.0	523	107	0	57	1.0	687	47	1	0	77	1.5	125	0.3	347	2.8	1,159
Task 4	Renewables Energy and Generic Environment	1,146	3.0	490	149	258	197	3.0	1,094	21	252	44	599	11.0	916	0.0	1,804	14.0	3,814
Task 5	Alternative Transportation Fuels	1,589	4.0	620	707	140	216	4.0	1,683	23	333	206	722	13.4	1,284	0.6	266	18.0	3,233
Task 6	Oil, Gas and Electricity	2,378	5.0	1,033	643	474	245	5.0	2,395	66	321	1,727	574	10.2	2,688	0.2	1,209	15.4	6,292
Total	Energy R&D Program	7,160	15.0	3,698	1,752	872	827	15.0	7,149	1,148	977	1,977	2,225	40.6	6,327	1.4	5,975	57.0	19,451

Figure 5 **DISTRIBUTION OF FUNDS BY TASK IN 1989-90TASK SUMMARIES**



TASK SUMMARIES

Introduction

The following descriptions highlight some of the major research activities undertaken by Environment Canada within the various Tasks. The reader is directed to the project descriptions for further details or individual research initiatives.

Task 1 - Energy Efficiency:

The Department's main objective in Task 1 - Energy Efficiency is to ensure the development of a science and technology base in end-use and efficiency, production, conservation and conversion of conventional and alternative energy sources. The Development and Demonstration of Resource and Energy Conservation Technology Program (DRECT), has been in operation since 1979, and continues to provide financial assistance to industry or municipalities for the development and demonstration of new or innovative technologies. DRECT also focuses on the development of processes or equipment that are intended to reduce energy consumption, and conserve resources through the reduction and recovery of hazardous and non-hazardous wastes.

Established in 1984, the National Incinerator Testing and Evaluation Program (NITEP) has successfully completed extensive research to identify the most appropriate energy-from-waste (EFW) technologies for use in Canada. Research work completed in NITEP includes the evaluation and assessment of the energy benefits, design optimization and examination of the effectiveness of various emission control designs. Information gathered under NITEP has provided essential information which culminated in the publication of Operating and Emission Guidelines for Municipal Solid Waste Incinerators by the Canadian Council of Ministers of the Environment. Tests recently completed in conjunction with the United States Environmental Protection Agency, on the final EFW technology, clearly demonstrated that EFW facilities can be designed and operated to significantly reduce all emissions of concern.

Other energy efficiency projects undertaken in the Task include: the optimization of sludge processing systems at sewage treatment plants; and characterization of emissions from Kraft recovery boilers at pulp and paper mills.

Task 2 - Coal:

The major research component of Task 2 - Coal Research and Development focuses on emissions control and waste reduction and disposal technologies for Canada's existing fossil-fuelled boilers. In cooperation with the Canadian Electrical Association, and Energy Mines and Resources, Environment Canada's research priorities focus on control technologies that reduce flue gas emissions, primarily the control of sulphur dioxide (SO_2), and secondly, the reduction of nitrogen oxides (NO_x) and carbon dioxide (CO_2). The coal R&D program considers technologies that are capable of reducing all three pollutants in the most cost-effective manner and in compliance with environmental standards.

Other Coal R&D projects include: the development of an analytical methodology for coal dust measurement in a particulate matrix; nutrient removal (mainly nitrogen and phosphorus) from coal mine wastewater; a study of the precipitation episodes and meteorological fields that contribute to high acidic wet deposition and elevated ozone concentrations; and technological solutions to reduce the impact of acid generation from coal rock waste.

Task 4 - Renewable Energy and Generic Environment:

Environment Canada continues to support the renewable energy program within Task 4 by providing data and information on renewable natural resources including wind, solar energy and hydrological data for small-scale hydro development. Researchers are also studying biomass production generated from pulp and paper wastewaters, and are active in the demonstration of anaerobic treatment technologies.

In its second year of operation, the Groundwater and Soil Remediation Program (GASReP) continues to sponsor and attract government-industry joint ventures to promote research, technology development and field demonstrations in the area of petroleum hydrocarbon contamination of groundwater and soils.

Departmental researchers and scientists also provide scientific advice and expertise on global climate change and greenhouse gases, the measurement of radiatively active gases, and the incorporation of the carbon cycle into two-dimensional climate models.

Under the International Energy Agency (IEA) Implementing Agreement, the Energy Technology Systems Analysis Programme (ETSAP) continues to provide a valuable, possibly unique international forum for collaborative modelling efforts to examine the most cost-effective blends of technological options to reduce national and regional emissions of greenhouse gases and secure national policy objectives such as energy security and environmental protection.

Task 5 - Alternative Transportation Fuels:

The Alternative Transportation Fuels Program involves studies of the environmental effects associated with the production and use of alternative transportation fuels, such as heavy oil and bitumen, natural gas, coal and biomass. The Program is designed to search for ways to reduce or eliminate environmental impacts through technology development.

Environment Canada's Wastewater Technology Centre's success story, namely the oil from sludge project is near the technological demonstration stage. The treatment process has been proven to yield a marketable diesel oil through the conversion of sewage sludge generated at municipal wastewater facilities.

In May 1989, Environment Canada organized a technical conference on the *Prevention and Treatment of Subsurface Contamination by Hydrocarbons from the Upstream Petroleum Industry*. This also involved the characterization of gas plant waste sludges, and development of technological solutions for the treatment of the waste and subsurface remediation procedures. One research project at Wastewater Technology Centre looks at the fate and effect of heavy oil and oil sands processing and product utilisation. During the combustion of these synthetic fuels, the emissions and waste streams are being evaluated and characterized for the presence of hazardous compounds such as heterocyclic nitrogenous compounds.

The River Road Environmental Technology Centre in Ottawa has established a comprehensive Vehicle Emissions Testing Laboratory. This facility enables researchers to assess and study the environmental implications of alternative transportation fuels when utilized in motor vehicles including heavy-duty vehicles.

The activities of Task 5 also involve research to evaluate the impacts of upstream oil sands and heavy oil development and to provide technological solutions for the treatment of wastewaters generated by extraction and transportation. A variety of studies are underway and include:

- the evaluation of the impact of disposal in deep wells of wastewaters generated from extraction;
- the development and demonstration of cost-effective treatment technologies for the recycling of produced water discharges from in-situ recovery of heavy oil and bitumen;
- the fate and persistence of heavy oil waste toxics on land treatment and the development of codes of practice for the land disposal of oily wastes;
- the demonstration of technology for the treatment of wastewater generated by the transportation of heavy oil in the form of an emulsion with water; and
- the assessment of the presence of natural and manmade polycyclic aromatic hydrocarbons on the Athabasca River.

Task 6 - Oil, Gas and Electricity:

Environment Canada contributes significantly to Task 6 activities in the area of offshore oil and gas exploration and development by providing information for the forecasting of sea, ice and weather conditions affecting offshore operations, and by researching the environmental impacts of hydrocarbon development on the marine environment in the Canadian Frontier.

Environmental design criteria of winds, waves and ice are much needed for the engineering design of marine structures. Research experts in the department are developing methodologies to assess extreme wind and wave hindcasting, methods to estimate the occurrence of combined environmental extreme events, and evaluating climatological data for Canadian waters including Grand Banks, Scotian Shelf, Beaufort Sea and the west coast. Wave dynamics including wave turbulence and shoaling waves are being studied in a wave pool at Environment Canada's National Water Research Institute in Burlington, Ontario.

Additional support to marine structural engineering lies in the area of ice and ice-structure interaction. Research projects include the development of a sea ice information system for Canadian waters; the study of marine icing using a wind tunnel and theoretical models; and the development of an ice digitization technology.

The focus of the environmental forecasting of sea, ice and weather conditions is addressed by developing technologies, methods and models to improve forecasts of environmental states for exploration, development and transportation of hydrocarbons.

The first part of the Canadian Atlantic Storm Program (CASP) concluded with the successful delivery of a comprehensive database of meteorological and oceanographic information on forecast of severe storm-related conditions in the Atlantic. The project has been well coordinated with the U.S. National Centre for Atmospheric Research. The data generated continues to be transferred to universities, other government departments including Fisheries and Oceans. The second component of CASP will focus its research on the meso-scale structure of Atlantic storms. An other weather research project called Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) continues to assess the nature of storms over the Atlantic ocean.

The ice reconnaissance detection network (IRDNET) ground station under completion will enable communications with selected satellites.

Additional environmental forecasting projects include:

- the development of an Ice Data Analysis and Integration System (IDIAS) capable of analyzing airborne radar and meteorological satellite imagery;
- the development of a model to assess oil spill mixing and dispersion by wind driven waves;
- the improved marine surface wind forecast techniques;
- the development of a spectral ocean wave forecasting model for Atlantic and Pacific waters; and
- the implementation of a simple ocean model to improve the Regional Ice Model.

Global warming is being addressed within the activities of oil and gas development. Studies are underway to determine the effect of climate change on pipeline construction in permafrost layers in the Mackenzie Valley region, and the possible future impacts on the east coast sea-ice and iceberg regimes for a period of 50-100 years.

Environmental impact research in Task 6 is targeted towards the improvement of present capabilities to reduce environmental impacts, develop mitigative technologies, assess the impacts and monitor the environmental effects of onshore and offshore hydrocarbon exploration, development and transportation.

Environment Canada's present focus is on the performance of alternative technologies for the treatment of oily brine wastewater from offshore oil production platforms. In addition, investigations are underway to evaluate on-line oil-in-water monitoring instruments. Analytical methodologies are being developed for the measurement of oil in oilfield brines. Similarly, an instrument is being developed for the detection and identification of hydrocarbons and plankton productivity on the surface and at depth in the ocean. Base oils and associated drilling fluid additives have been evaluated for their biodegradability.

Although most of the research effort in Task 6 is targeted towards the offshore environment, some ongoing R&D activity is direct towards the western Canada sedimentary basin. Gas plant sludge wastes and flare stack emissions are studied to find ways to reduce environmental impacts.

SOMMAIRE

Programme de R et D énergétiques

Environnement Canada est un participant majeur au Programme fédéral de recherche et développement énergétiques. De concert avec le Groupe interministériel de recherche et développement énergétiques (GRDE) et d'autres collaborateurs, tels l'industrie ou des organismes provinciaux, Environnement Canada promeut la recherche dans les domaines de la lutte contre la pollution, de la gestion des déchets ainsi que de la santé et de la sécurité. Certes, priorité est accordée aux préoccupations strictement environnementales, mais Environnement Canada, par l'intermédiaire du GRDE, joue lui aussi un rôle dans la mise en valeur des énergies douces, comme les carburants de remplacement et les énergies renouvelables.

Le présent rapport donne un aperçu du Programme fédéral de recherche et développement énergétiques d'Environnement Canada en ce qui concerne le GRDE. Il est centré sur les projets de recherche correspondant directement aux ressources du Groupe et laisse de côté les programmes relatifs à l'énergie et à l'environnement qui ne peuvent être financés que par les services votés d'Environnement Canada.

Ressources financières et années-personnes

En 1989-1990, les ressources totales du GRDE affectées à tous les ministères participants se sont élevées à 90,1 millions de dollars et à 202 années-personnes. La part d'Environnement Canada a dépassé un peu 7,1 millions de dollars et 15 années-personnes. Outre les dépenses au titre du Programme de R et D énergétiques, la contribution d'Environnement Canada puisée à même les services votés a été de 6,3 millions de dollars et de 41 années-personnes. L'aide des établissements provinciaux de recherche, du secteur privé, des universités et des institutions internationales est montée à 6 millions de dollars et à environ une année-personne. Les dépenses totales au titre du Programme de R et D énergétiques d'Environnement Canada ont représenté quelque 19,5 millions de dollars et 50 années-personnes. La baisse de l'aide financière issue d'autres sources tient à la quantité de projets qui commençaient ou finissaient. Sur les 52 projets entrepris en 1989-1990, 40 % en étaient à ces stades.

En 1989-1990, l'administration du Programme de R et D énergétiques d'Environnement Canada est passée du Service des politiques du Ministère au Bureau du conseiller scientifique (BCS).

Introduction

En septembre 1988, le gouvernement du Canada a reconfirmé son engagement à l'égard du Programme fédéral de R et D énergétiques. Par cette décision, le Programme était approuvé pour quatre autres années (1989-1990 à 1991-1992, avec approbation théorique pour 1992-1993) et délaissait les combustibles fossiles pour l'utilisation rationnelle de l'énergie, les énergies nouvelles et les effets de l'offre et de la consommation de l'énergie sur l'environnement. Ce changement de cap répondait également aux événements internationaux, notamment l'orientation annoncée par l'Agence internationale de l'énergie (AIE), dont fait partie le Canada.

Ces événements et d'autres faits ont agi sur l'orientation de l'objectif du GRDE, qui a été repris de façon à refléter la nécessité d'aborder, en fonction du patrimoine commun, les enjeux touchant l'avenir à long terme des ressources naturelles du monde. En 1989, l'objectif du Programme a été redéfini en fonction de l'objectif principal suivant :

> *établir, en matière de sciences et de technologie, une base pour soutenir un marché de l'énergie diversifié et viable sur les plans économique et environnemental*[1].

Ainsi que l'énonce le Plan du Programme, le GRDE n'est qu'un des éléments des investissements canadiens dans la technologie énergétique. Il s'agit d'un programme essentiel qui porte sur des domaines que le secteur privé ne saurait soutenir à lui seul.

> *Sans les renseignements techniques fournis par le Programme, le gouvernement serait vulnérable lorsqu'il prend des décisions de caractère énergétique qui ont des incidences sur l'environnement ainsi que sur la santé et la sécurité du public. Cela s'applique particulièrement aux mesures d'efficacité énergétique, au charbon, aux carburants de remplacement ainsi qu'à l'exploitation pétrolière et gazière dans les régions pionnières*[2].

Exécution du Programme

Le Programme fédéral de R et D énergétiques est une entreprise interministérielle unique en son genre. Environnement Canada, qui joue un rôle important, reçoit environ 8 % des fonds puisés au Programme (illustration 1). Le Groupe, qui est du niveau des SMA et dont Environnement Canada fait partie, est chargé de la gestion et de la coordination globales ainsi que de l'exécution du Programme de R et D énergétiques. À ce titre, le Groupe est chargé de conseiller le Conseil du Trésor sur la répartition des fonds à consacrer à la R et D énergétiques. Le Groupe :

> *coordonne les activités de R et D énergétiques au sein du gouvernement fédéral, y compris l'approche fédérale des grandes initiatives internationales et fédérales-provinciales, suit l'évolution de l'ordre du jour environnemental du gouvernement et module le Programme en conséquence, assure l'échange de renseignements sur la politique et les stratégies énergétiques qui pourraient infléchir l'orientation des programmes fédéraux de R et D énergétiques*[3].

Le Groupe permet la discussion et la coopération interministérielles, donnant suite à divers objectifs du gouvernement. Le Bureau de R et D énergétiques (BRDE) d'EMR fait fonction de secrétariat auprès du Groupe.

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1 Guide 1989 des activités du Groupe interministériel de recherche et développement énergétiques du gouvernement du Canada, Bureau de recherche et développement énergétiques (BRDE), EMR, 1989.

2,3 Plan of the Energy Research and Development Program of the Interdepartpartmental Panel on Energy Research and Development of the Government of Canada, BRDE, EMR, 1990.

Illustration 1 RÉPARTITION DES FONDS EN 1989-1990 PAR MINISTÈRE FONDS DU GROUPE AFFECTÉS À LA R et D ÉNERGÉTIQUES (EN MILLIONS DE DOLLARS DE 1989-1990)

Ministères :

Agr	Agriculture Canada
AINC	Affaires indiennes et Nord Canada
DN	Défense nationale
EACL	Énergie atomique du Canada Ltée
EC	Environnement Canada
EMR	Énergie, Mines et Ressources
ForCan	Forêts Canada
P&O	Pêches et Océans
SBSC	Santé et bien-être social Canada
SCHL	Société canadienne d'hypothèques et de logement
TC	Transports Canada
TPC	Travaux publics Canada

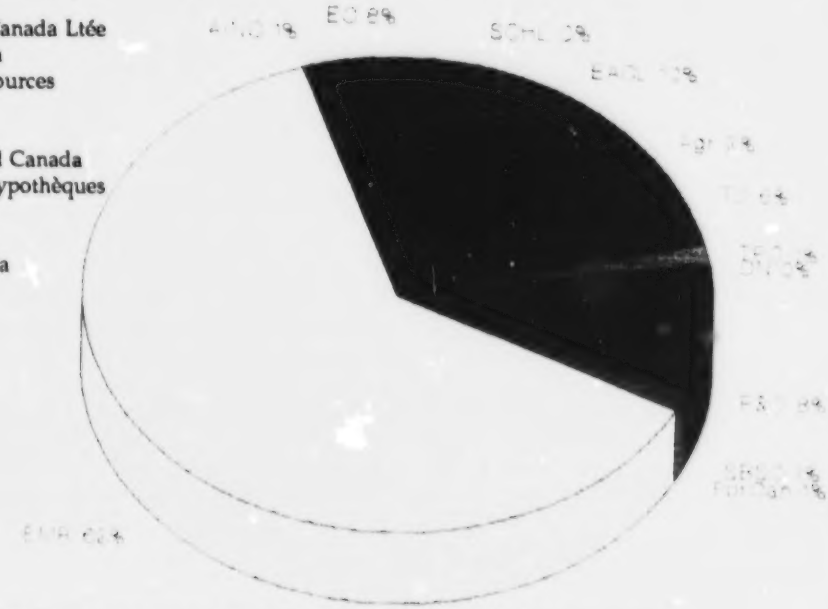
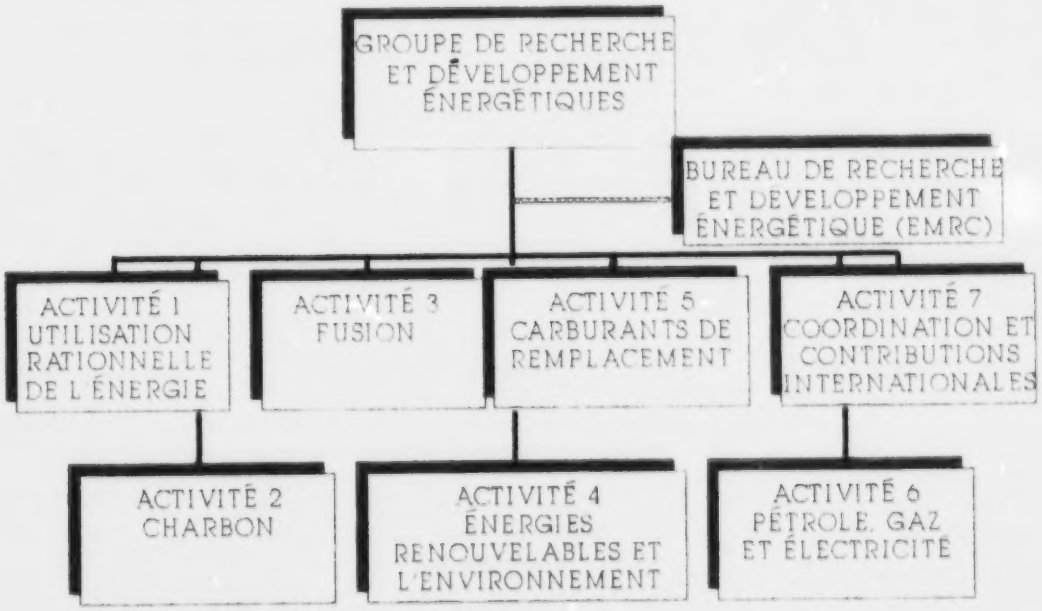


Illustration 2 STRUCTURE FÉDÉRALE DE COORDINATION DE LA R ET D ÉNERGÉTIQUES


GROUPE DE RECHERCHE ET DÉVELOPPEMENT ÉNERGÉTIQUES
BUREAU DE RECHERCHE ET DÉVELOPPEMENT ÉNERGÉTIQUE (EMRC)
ACTIVITÉ 1 UTILISATION RATIONNELLE DE L'ÉNERGIE
ACTIVITÉ 3 FUSION
ACTIVITÉ 5 CARBURANTS DE REMPLACEMENT
ACTIVITÉ 7 COORDINATION ET CONTRIBUTIONS INTERNATIONALES
ACTIVITÉ 2 CHARBON
ACTIVITÉ 4 ÉNERGIES RENOUVELABLES ET L'ENVIRONNEMENT
ACTIVITÉ 6 PÉTROLE, GAZ ET ÉLECTRICITÉ

Activités du Programme

Le Programme de R et D énergétiques s'articule autour des sept grands domaines suivants, appelés "activités" (illustration 2) :

Activité 1 - Utilisation rationnelle de l'énergie
Activité 2 - Charbon
Activité 3 - Fusion
Activité 4 - Énergies renouvelables et environnement général
Activité 5 - Carburants de remplacement
Activité 6 - Pétrole, gaz et électricité
Activité 7 - Coordination et participation internationales

L'illustration 3 montre la répartition des ressources ministérielles du PRDE que les partenaires ont dépensées dans le cadre du Programme. L'illustration 4 montre l'accroissement de la participation du Ministère et des partenariats avec l'industrie au fil des ans. Environnement Canada oeuvre dans toutes les activités sauf les activités 3 et 7. L'illustration 5 indique la répartition des fonds ministériels entre les diverses activités du GRDE. Des détails complets sur les ressources affectées sont donnés, par activité, au tableau 1.

Les ressources du GRDE à Environnement Canada viennent augmenter les budgets de recherche actuels afin d'accélérer et de coordonner la suite donnée par le Ministère aux objectifs fédéraux dans les domaines de l'énergie et de l'environnement. Par ailleurs, le Programme doit être compatible avec le Cadre décisionnel en matière de sciences et de technologie. Environ 57 % du Programme de R et D énergétiques d'Environnement Canada est confié à contrat à plusieurs entreprises, services publics, organismes de recherche provinciaux et universités.

Les apports extérieurs sont également essentiels aux efforts qu'Environnement Canada consacre au Programme. En 1989-1990, le Programme est allé chercher environ 6 millions de dollars à l'extérieur. Les principaux partenaires étaient notamment les suivants : l'Association pétrolière du Canada, les Industries Fournier, Superwood Ontario, International Pigments and Colours, l'Agence de protection de l'environnement des États-Unis, le ministère de l'Environnement de l'Ontario, l'Agence internationale de l'énergie, le Conseil consultatif de la recherche environnementale, l'Office of Naval Research et la National Science Foundation des É.-U.

Évaluation et examen du Programme

Les projets de R et D énergétiques sont élaborés en fonction des services votés et sont assujettis aux mêmes examens rigoureux. Les examens annuels des projets par des gestionnaires hiérarchiques supposent des consultations au sein du Ministère ainsi qu'auprès d'autres ministères et du secteur privé pour que le rendement et la valeur technique soient déterminés et évalués par des pairs. L'examen annuel, à l'échelle du Ministère, des priorités de recherche tient compte des avis donnés aux ministres par les comités d'examen formés de représentants des secteurs privé et universitaire et des gouvernements provinciaux. La R et D énergétiques sont évaluées en tant qu'élément des activités annuelles du Ministère en sciences et en technologie. Le Programme de R et D énergétiques du Ministère est également revu chaque année pour en assurer l'uniformité avec les autres programmes fédéraux de R et D. Environnement Canada fournit en permanence des compétences au GRDE en :

1) caractérisant les polluants attribuables à la production et à l'utilisation des ressources énergétiques;
2) élaborant des façons de réduire les émissions, les effluents et les déchets solides;
3) établissant des directives et des codes de pratiques en matière de protection de l'environnement;
4) évaluant des conditions environnementales, comme l'hydrologie, la météorologie et les énergies renouvelables.

Illustration 3 RESSOURCES DÉPENSÉES PAR LES PARTENAIRES DU PROGRAMME EN 1989-1990

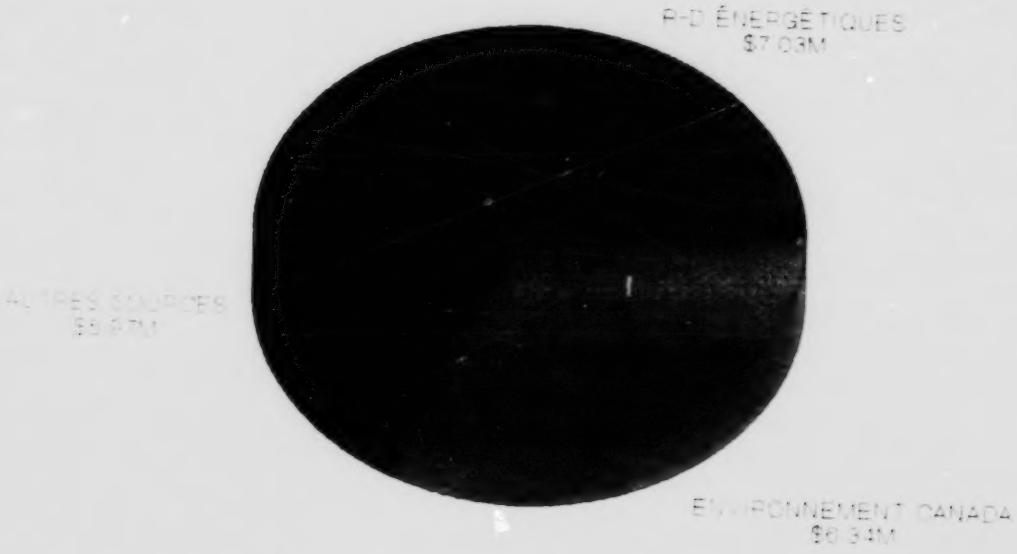


Illustration 4 RÉPARTITION ANNUELLE DES RESSOURCES DE LA PARTICIPATION D'ENVIRONNEMENT CANADA ET DE SES PARTENARIATS AVEC L'INDUSTRIE

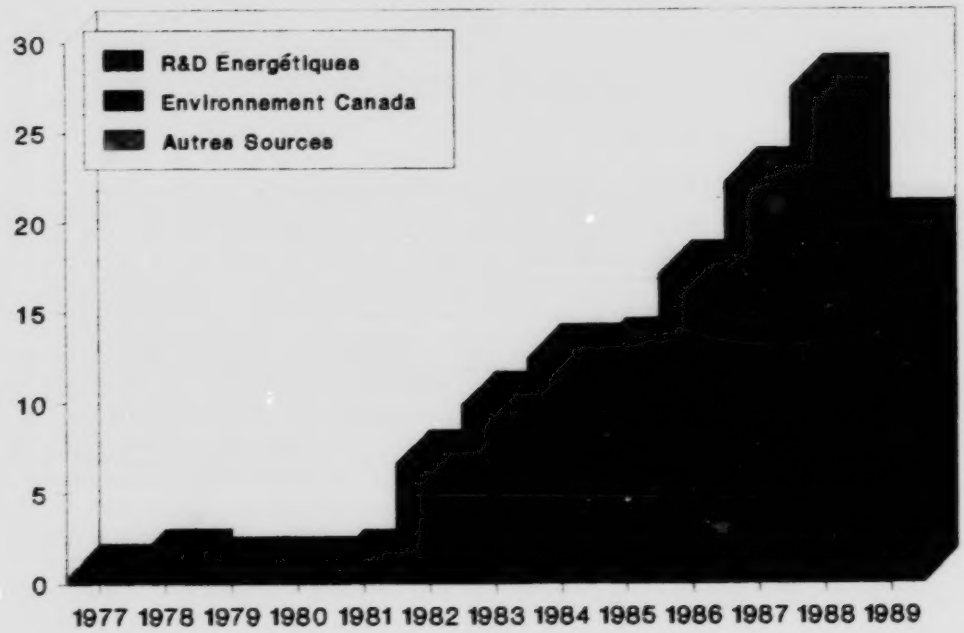
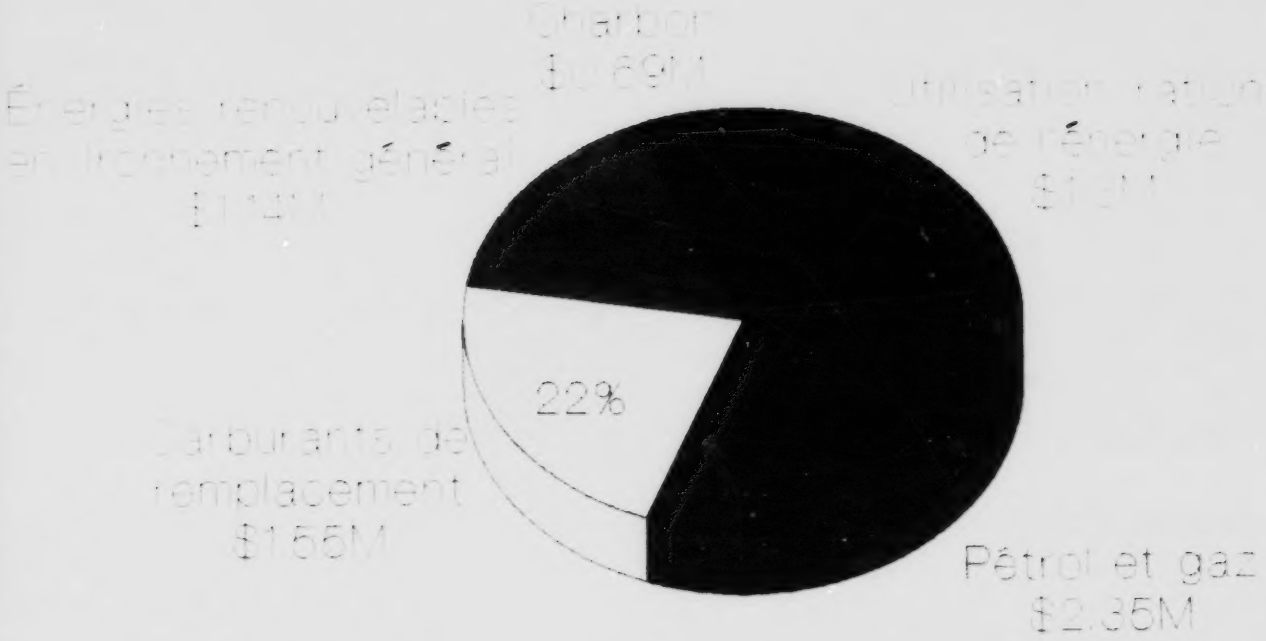


Tableau 1: Détail des ressources par activité

Programme de R et D énergétiques GRDE Résumé de toutes les dépenses au titre des activités																		
Proj. n°	Désignation	Proposé en 1989-1990		Dépensé en 1989-1990 (K$ et AP)														
				Groupe de recherche et développement énergétiques						Environnement Canada						Autres sources de financement		Total	
		K$	AP	Marché $K	F&E $K	Capit $K	V&B $K	V&B PY	Total $K	Marché $K	F&E $K	Capit $K	V&B $K	V&B PY	Total $K	V&B PY	Total $K	V&B PY	Total $K
Act. 1	Utilisation rationnelle de l'énergie	1,379	2.0	1,032	146	0	112	2.0	1,290	991	70	0	253	4.5	1,314	0.3	2,349	6.8	4,953
Act. 2	Charbon	668	1.0	523	107	0	57	1.0	687	47	1	0	77	1.5	125	0.3	347	2.8	1,159
Act. 4	Énergie renouvelables et environnement générique	1,146	3.0	490	149	258	197	3.0	1,094	21	252	44	599	11.0	916	0.0	1,804	14.0	3,814
Act. 5	Carburants de Remplacement	1,589	4.0	620	707	140	216	4.0	1,683	23	333	206	722	13.4	1,284	0.6	266	18.0	3,233
Act. 6	Pétrole, gaz et Électricité	2,378	5.0	1,033	643	474	245	5.0	2,395	66	321	1,727	574	10.2	2,688	0.2	1,209	15.4	6,292
Total	Programme de R et D énergétiques	7,160	15.0	3,698	1,752	872	827	15.0	7,149	1,148	977	1,977	2,225	40.6	6,327	1.4	5,975	57.0	19,451

Illustration 5 RÉPARTITION DES FONDS PAR ACTIVITÉ EN 1989-1990



RÉSUMÉ DES ACTIVITÉS

Introduction

Les descriptions suivantes mettent en lumière quelques-unes des principales réalisations du Programme de R et D énergétiques d'Environnement Canada dans le cadre des diverses activités. Le lecteur peut se reporter aux descriptions des projets pour obtenir de plus amples renseignements ou connaître des initiatives de recherche particulières.

Activité 1 - Utilisation rationnelle de l'énergie

Le principal objectif du Ministère pour l'Activité 1 - Utilisation rationnelle de l'énergie consiste à assurer l'établissement d'une base en sciences et en technologie pour la consommation finale et rationnelle, la production, la conservation et la conversion des énergies traditionnelles et nouvelles. Le Programme de création et de démonstration de techniques d'économie des ressources et de l'énergie (DRECT) existe depuis 1979 et continue d'aider financièrement les entreprises et des municipalités à mettre au point et en évidence des techniques nouvelles ou novatrices. En outre, le DRECT privilégie l'élaboration de procédés ou de matériels destinés à réduire la consommation d'énergie et à conserver les ressources par la réduction et la récupération des déchets dangereux et inoffensifs.

Créé en 1984, le Programme national d'essais et d'évaluation des incinérateurs (PNEEI) a permis de mener à bien des recherches poussées visant à trouver les meilleures technologies de transformation des déchets en énergie pour le Canada. Les travaux de recherche terminés dans le cadre du PNEEI comprennent l'étude préalable et l'évaluation des avantages énergétiques, l'optimisation des dispositifs et l'examen de l'efficacité de divers dispositifs de lutte contre les émissions. Les renseignements recueillis dans le cadre du PNEEI ont fourni les données essentielles qui ont abouti à la publication, par le Conseil canadien des ministres de l'Environnement, des Lignes directrices relatives au fonctionnement et aux émissions des incinérateurs de déchets solides urbains. Des essais, récemment effectués de concert avec l'Agence de protection de l'environnement des États-Unis, sur la technique de la transformation finale des déchets en énergie ont clairement montré que des installations peuvent être conçues et exploitées de façon à réduire de beaucoup toutes les émissions préoccupantes.

Les autres projets d'utilisation rationnelle de l'énergie sont l'optimisation des systèmes de traitement des boues aux stations d'épuration ainsi que la caractérisation des émissions attribuables aux chaudières de récupération pour le procédé kraft aux usines de pâtes et papiers.

Activité 2 - Charbon

Le principal volet "recherche" de l'Activité 2 - Charbon porte sur les technologies de lutte contre les émissions ainsi que de réduction et d'élimination des déchets pour les actuelles chaudières au combustible fossile. De concert avec l'Association canadienne de l'électricité et Énergie, Mines et Ressources, Environnement Canada consacre en priorité ses recherches aux technologies de lutte qui permettent de diminuer les effluents gazeux, notamment par la limitation du dioxyde de soufre (SO_2), et ensuite à la réduction des oxydes d'azote (NO_x) et du dioxyde de carbone (CO_2). Le programme de R et D sur le charbon examine les technologies propres à réduire les trois polluants de la manière la plus efficace et en conformité avec les normes environnementales.

Les autres projets de R et D sur le charbon sont l'élaboration d'une méthode analytique de la mesure des poussières de charbon dans une matrice de particules, l'élimination des nutriments (surtout l'azote et le phosphore) des eaux usées des mines de charbon, l'étude des épisodes de précipitation et des champs météorologiques qui contribuent aux fortes retombées acides humides et aux teneurs élevées en ozone, ainsi que les solutions technologiques permettant de réduire l'incidence de la production acide due aux débris de charbon.

Activité 4 - Énergies renouvelables et environnement général

Environnement Canada continue d'appuyer l'Activité 4 - Énergies renouvelables et environnement général en fournissant des données et des renseignements sur les ressources naturelles renouvelables, y compris des données sur les vents, l'énergie solaire et l'hydrologie pour les petites centrales hydroélectriques. Les chercheurs étudient également la biomasse produite par les eaux usées des usines de pâtes et papiers et oeuvrent dans la démonstration des technologies de traitement anaérobie.

Dans sa deuxième année d'existence, le Programme de restauration des eaux souterraines et des sols contaminés (PRESSC) continue de parrainer et d'attirer des coentreprises gouvernement-industrie visant à promouvoir la recherche, la mise au point de technologies et les démonstrations sur le terrain dans le domaine de la contamination des eaux souterraines et des sols par les hydrocarbures non gazeux.

Des chercheurs et des scientifiques du Ministère fournissent également conseils et compétences pour les changements climatiques à l'échelle du globe et pour les gaz à effet de serre, la mesure des gaz rayonnants et l'incorporation du cycle du carbone à des modèles climatiques bidimensionnels.

En vertu de l'Accord de mise en oeuvre de l'Agence internationale de l'énergie (AIE), le Programme d'analyse des systèmes de la technologie énergétique (ETSAP) constitue toujours un moyen international précieux, voire unique, de mise en commun des efforts de modélisation visant à examiner les dosages les plus rentables d'options technologiques propres à réduire les émissions nationales et régionales de gaz à effet de serre et à atteindre des objectifs généraux nationaux, comme la sécurité énergétique et la protection de l'environnement.

Activité 5 - Carburants de remplacement

L'Activité 5 - Carburants de remplacement comprend des études des effets environnementaux de la production et de l'utilisation des carburants de remplacement, comme le pétrole lourd et le bitume, le gaz naturel, le charbon et la biomasse. L'activité cherche des moyens de réduire ou d'éliminer les incidences environnementales par la mise au point de technologies.

La grande réussite du Centre technique des eaux usées d'Environnement Canada - le projet de production de pétrole à partir de boues - en est presque à l'étape de la démonstration technique. Il a été prouvé que le processus de traitement donne du gazole commercialisable par la conversion des boues d'égout produites par les stations d'épuration municipales.

En mai 1989, Environnement Canada a organisé une conférence technique intitulée La prévention et le traitement de la contamination souterraine par les hydrocarbures produits par l'industrie pétrolière aval. Cette conférence portait également sur la caractérisation des boues usées des centrales au gaz et sur l'élaboration de solutions technologiques pour le traitement des déchets et les procédures de remise en état du sous-sol. L'un des projets de recherche menés au Centre technique des eaux usées porte sur le devenir et l'effet du traitement du pétrole lourd et des sables pétrolifères ainsi que sur l'utilisation de leurs produits. Lors de la combustion de ces carburants de synthèse, les émissions et les flux de déchets sont évalués et la présence de substances dangereuses, comme les composés azotés hétérocycliques, est dépistée.

Le Centre environnemental de River Road a créé un laboratoire complet d'analyse des gaz d'échappement des véhicules. Celui-ci permet aux chercheurs d'évaluer et d'étudier les effets environnementaux des carburants de remplacement utilisés dans les véhicules, y compris les véhicules lourds.

L'activité 5 comporte également des recherches visant à évaluer les incidences des sables pétrolifères aval et de l'exploitation du pétrole lourd ainsi qu'à trouver des solutions technologiques pour le traitement des eaux usées produites par l'extraction et le transport. Diverses études sont en cours, notamment :

- l'évaluation de l'impact de l'élimination en puits profonds des eaux usées produites par l'extraction;

- la mise au point et la démonstration de technologies de traitement rentables pour le recyclage des eaux rejetées par la récupération sur place du pétrole lourd et du bitume;

- le devenir et la persistance des déchets toxiques du pétrole lourd, leur traitement et l'établissement de codes de pratiques visant l'élimination des déchets de pétrole sur le sol;

- la démonstration de la technologie du traitement des eaux usées produites par le transport du pétrole lourd sous forme d'émulsions dans l'eau;

- l'évaluation de la présence d'hydrocarbures aromatiques polycycliques naturels et artificiels dans la rivière Athabasca.

Activité 6 - Pétrole, gaz et électricité

Environnement Canada contribue fortement à l'activité 6 dans le domaine de l'exploration et de l'exploitation du pétrole et du gaz en mer en fournissant des renseignements qui servent à prévoir les conditions de la mer, des glaces et du temps touchant les opérations extracôtières et en cherchant les impacts environnementaux de l'exploitation des hydrocarbures sur le milieu marin dans les zones pionnières du Canada.

Il faut absolument des critères théoriques environnementaux des vents, des vagues et des glaces pour assurer la conception technique des ouvrages en mer. Des chercheurs du Ministère sont en train d'élaborer des méthodes pour analyser les prévisions a posteriori des vents et des vagues extrêmes afin d'estimer la survenue d'événements extrêmes combinés et d'évaluer les

données climatologiques pour les eaux canadiennes, y compris les Grands Bancs, la plate-forme Scotian, la mer de Beaufort et la côte ouest. La dynamique des vagues, y compris la turbulence des vagues et les vagues réfractées sur les hauts-fonds, sont étudiées dans un bassin à vagues situé à l'Institut national de recherche sur les eaux d'Environnement Canada à Burlington (Ontario).

Le domaine de l'interaction glaces-structure des glaces fournit un appui supplémentaire à la technique de la construction des ouvrages en mer. Les projets de recherche comprennent l'établissement d'un système de renseignements sur les glaces marines pour les eaux canadiennes, l'étude de l'englacement des mers à l'aide d'une soufflerie et de modèles théoriques ainsi que l'élaboration d'une technologie de numérisation des glaces.

L'accent est mis sur les prévisions environnementales des conditions de la mer, des glaces et du temps grâce à la mise au point de techniques, méthodes et modèles propres à améliorer les prévisions des états environnementaux en vue de l'exploration, de l'exploitation et du transport des hydrocarbures.

La première partie du Programme canadien d'étude des tempêtes dans l'Atlantique (CASP) a abouti à la création d'une base complète de données météorologiques et océanographiques pour la prévision des conditions liées aux fortes tempêtes dans l'Atlantique. Le projet a bien été coordonné avec le National Centre for Atmospheric Research des É.-U. Les données engendrées continuent d'être transmises à des universités et à d'autres ministères, dont Pêches et Océans. Le deuxième élément du CASP privilégiera la recherche sur la mésostructure des tempêtes dans l'Atlantique. Dans le cadre d'un autre projet de recherche météorologique, appelé Expérience sur les cyclones à évolution rapide dans l'Atlantique (ERICA), la nature des tempêtes dans l'océan Atlantique continue d'être évaluée.

La station terrienne du Réseau de données de la reconnaissance des glaces (RDRG), en voie d'achèvement, permettra de communiquer avec certains satellites.

Les autres projets de prévision environnementale sont les suivants :

- l'élaboration d'un Système d'analyse et d'intégration de renseignements sur les glaces (SAIRG) capable d'analyser l'imagerie par radar aéroporté et par satellite météorologique;

- l'établissement d'un modèle pour évaluer le mélange et la dispersion des déversements de pétrole par les vagues poussées par le vent;

- l'amélioration des techniques de prévision des vents à la surface des mers;

- l'établissement d'un modèle spectral de prévision des vagues océaniques pour les eaux de l'Atlantique et du Pacifique;

- la mise en oeuvre d'un modèle océanique simple pour améliorer le Modèle régional des glaces.

La question du réchauffement de la planète est actuellement examinée dans le cadre des activités d'exploitation pétrolière et gazière. Des études sont en cours pour déterminer l'effet des changements climatiques sur la construction des pipelines dans les couches de pergélisol de la région de la vallée du Mackenzie ainsi que les éventuelles incidences des régimes des glaces marines et des icebergs de la côte est pendant une période de 50-100 ans.

Les recherches sur l'impact environnemental effectuées dans le cadre de l'activité 6 visent à améliorer la capacité actuelle de réduire les incidences environnementales, à élaborer les technologies d'atténuation ainsi qu'à évaluer et à surveiller les effets environnementaux de l'exploration de l'exploitation et du transport des hydrocarbures à terre et en mer.

Environnement Canada met l'accent sur le rendement des techniques nouvelles de traitement des eaux saumâtres huileuses rejetées par les plates-formes de forage en mer. En outre, des études sont en cours pour évaluer les appareils de détection en direct de l'huile dans l'eau. Des méthodes analytiques sont élaborées pour mesurer les eaux saumâtres présentes dans les champs pétrolifères. De même, un instrument est mis au point pour détecter et déceler les hydrocarbures et la productivité planctonique à la surface et dans les profondeurs de l'océan. La biodégradabilité des huiles de base et des additifs des liquides de forage a été évaluée.

Bien que la plupart des efforts de recherche déployés au titre de l'activité 6 visent l'environnement extracôtier, certains efforts permanents de R et D portent sur le bassin sédimentaire de l'ouest du Canada. Les boues usées des centrales au gaz et les émissions des torchères sont étudiées pour trouver des moyens d'en réduire les impacts environnementaux.

TASK 1

ENERGY EFFICIENCY

Energy R&D Program
PERD Task 1 Expenditure Summary

Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)															
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
12201	DRECT	948	2.0	732	102	0	112	2.0	946	84	20	0	152	2.7	256	0.0	1775	4.7	2,977
12203	NITEP	300	0.0	300	0	0	0	0.0	300	907	50	0	84	1.5	1,041	0.0	557	1.5	1,898
12204	Sewage Treatment	0	0.0	0	27	0	0	0.0	27	0	0	0	17	0.3	17	0.0	0	0.3	44
12305	Pulp and Paper	131	0.0	0	17	0	0	0.0	17	0	0	0	0	0.0	0	0.3	17	0.3	34
TASK1	Energy Efficiency	1,379	2.0	1,032	146	0	112	2.0	1,290	991	70	0	253	4.5	1,314	0.3	2,349	6.8	4,953

1. Title: Development & Demonstration of Resource & Energy Conservation Technology (DRECT)

2. Project #: 12201(A)

3. TASK 1 - ENERGY EFFICIENCY
PROGRAM 1.2 - INDUSTRY
SUBPROGRAM 1.2.2 - WASTE RECOVERY TECHNOLOGY

4. Project Management:
a) Project Manager(s): Adrian S. Ross
b) Service: EC/C&P
c) Address: Ottawa, Ontario
d) Phone Number: (613) 991-1958

5. Project Objective(s):

To develop hardware, techniques and systems to maximize opportunities for saving or recovering energy through waste reduction and recycle/re-use of waste materials.

6. Project Accomplishment(s):

There were 12 active projects reported by the DRECT program in 1988/89. Six projects were a continuation of contracts signed in previous years and six new contracts were initiated. Five projects were concluded in 1989-90 and five technical reports were prepared.

Projects in the program include the following:

a) Demonstration of a Kamyr Rotary Ring Press for Dewatering Pulp and Paper Mill Primary Clarifier Sludges: The Kamyr Rotary Ring Press (Fig.1) is designed to dewater fibrous suspensions which can then be burned in a boiler to generate steam. The use of the sludge that would normally be disposed through landfill can contribute to the reduction of fossil fuels required for the operation of a pulp and paper mill.

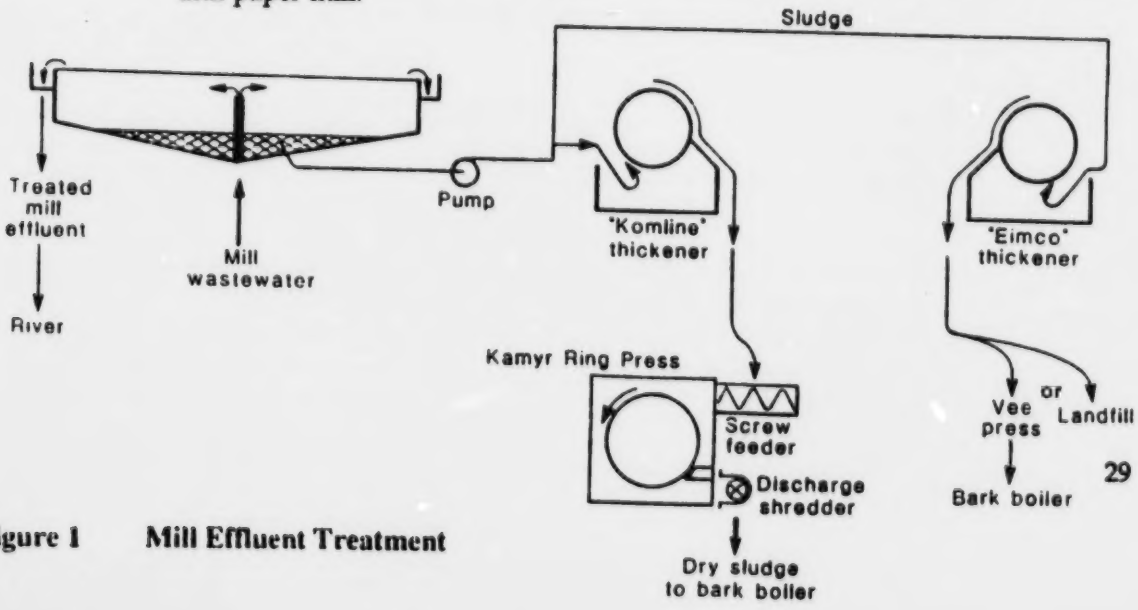


Figure 1 Mill Effluent Treatment

b) Continuation of the development and optimization of a municipal waste recycling centre for a medium-sized municipality (50,000). The environmental and energy-saving benefits of a 25 % reduction in municipal waste disposal, will enable a municipality to become self-sufficient and move toward break-even cost positions in its recycling activity.

c) Development and Demonstration of a Treatment/Recovery System for the Pigment Industry: This project is a continuation of the demonstration of a prototype for treating liquid effluent discharging from an organic and inorganic pigment manufacturing process. The new technology will remove suspended solids and ionic metal from the effluent, and recycle recovered material back into the pigment production process. This development presents an opportunity for industry to comply with environmental regulations while reducing raw material requirements, saving energy, and reducing production costs.

d) Completion of the development and demonstration of a energy efficient method of cleaning septic tanks. The cleaning procedure involves the use of pumping equipment and compartmented storage tanks enabling the selective cleaning of concentrated sludge. The "selective cleaning" vacuum truck allows for an efficiency of 2 to 3 times greater than conventional trucks, and eliminates the necessity of further treatment prior to the composting of the concentrated sludge.

e) Continuation of a monitoring study to assess the technical and economical viability of a demonstration of a copper/recovery waste management system for a printed circuit board manufacturing facility.

f) Continuation of the development and evaluation of an iron oxide recycling system for the recovery of dusts from the steel industry. The iron, zinc and lead contained in these recyclable iron oxide fines previously landfilled will be recovered and recycled using rotary kiln technology.

g) Demonstration of a Plastics Recycling Process for Post-consumer Plastics: This project includes the initiation of the contract for the demonstration of a plastic recycling machine technology to manufacture saleable recycled plastic using waste shredded and ground from the "blue box" curb-side recycling program. This Irish technology has a recycling potential of 1,000 tonnes of plastic a year which could save 16,500 barrels of oil.

h) Work is under way with the Canadian Council of Ministers of the Environment (CCME) for the development of a Packaging Protocol for the Packaging Industry in Canada. This protocol will assist the packaging industry in enhancing reduction, reuse and recycling (3R) management.

i) Initial work is underway for the development and demonstration of a portable chemical processing unit for recovering waste gas treating chemicals from the petroleum industry. This new technology offers the petroleum industry an opportunity to economically regenerate waste fluids, reduce total waste volume and save energy that would be required to manufacture and dispose of process chemicals.

j) Continuation of the development and demonstration of a Rotary Ring Press that is capable of dewatering a variety of industrial sludges. The project involves the design and construction of a mobile experimental rotary ring press which will be transported to three pre-selected industrial sites for evaluation and development. The outcome of the project will be operating criteria and a design for full-scale sludge dewatering equipment to be used by industry.

k) Completion of the development of an automated program management system for the DRECT program. The system allow for the financial control and status for each DRECT project.

7. Publications/Papers/Reports in 1989-90:

Environment Canada (1989). *Development of a System to Combine Solvent Recovery with the Recovery of Heat from Residual Organic Wastes*, report EPS3/C/1.

Environment Canada (1989). *Treatment of Lead-Bearing Residues in a Rotary Kiln*, report EPS3/HA/6.

Environment Canada (in press). *Safe Handling and Burning of Waste Fuels in a Cement Kiln, Woodstock Resource Recovery Project.*

Environnement Canada (1990). *Récupération des protéines pour le prétraitement des eaux résiduaires de laiterie: Projet Agrinove Inc.*

Environnement Canada (1990). *Récupération du chrome hexavalent dans les eaux résiduaires des installations de traitement des surfaces métalliques: Projet Thermonic Inc.*

8. Proposed PERD Resources: $948K (2.0 PY)

9. Resources Expended:

	O&M		SAL. & BEN.		CAP.	TOTAL	
	Contract	Other	$K	PY	$K	$K	PY
PERD	732.00	60.00	112.00	2.00	0.00	904.00	2.00
EC	84.20	20.00	84.70	1.50	0.00	188.90	1.50
OTHERS:							
Re-Met	316.00	0.00	0.00	0.00	0.00	316.00	0.00
CIP	100.00	0.00	0.00	0.00	0.00	100.00	0.00
CND Chem.	139.00	0.00	0.00	0.00	0.00	139.00	0.00
C.C.M.E.	200.00	0.00	0.00	0.00	0.00	200.00	0.00
Town of Hay River	55.00	0.00	0.00	0.00	0.00	55.00	0.00
Circtronics	45.00	0.00	0.00	0.00	0.00	45.00	0.00
Ont. MOE	15.00	0.00	0.00	0.00	0.00	15.00	0.00
Inter Pigments	200.00	0.00	0.00	0.00	0.00	200.00	0.00
Superwood Ont.	435.00	0.00	0.00	0.00	0.00	435.00	0.00
Récupération Bois Francs	70.00	0.00	0.00	0.00	0.00	70.00	0.00
Les Industries Fournier	200.00	0.00	0.00	0.00	0.00	200.00	0.00
TOTAL	2,591.20	80.00	195.70	3.50	0.00*	12,867.9	3.50

13. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Récreation Gaudreau Inc.	Quebec		75.00
Canadian Pacific Forest Products Ltd.	Quebec		200.00
International Pigments and Colours	Quebec		125.00
Les Industries Fournier	Quebec		150.00
Fossetic Inc.	Quebec		12.40
Circtronics Inc.	Ontario		75.00
Re-Met Processing Inc.	Ontario		150.00
Superwood Ontario Ltd.	Ontario		200.00
MacLaren Engineers	Ontario		300.00
Canadian Chemical Reclaiming Ltd.	Alberta		119.00
Municipality of Hay River	NWT		52.00
Influatec Systems Inc.	Quebec		15.00
TOTAL CONTRACTS			1473.40

1. Title: Development & Demonstration of Resource & Energy Conservation Technology (DRECT) - Recycling

2. Project #: 12201(B)

3. TASK 1 - **ENERGY EFFICIENCY**
PROGRAM 1.2 - INDUSTRY
SUBPROGRAM 1.2.2 - WASTE RECOVERY TECHNOLOGY

4. Project Management:

a) Project Manager(s):	George Hill	John Myslicki
b) Service:	EC/C&P	EC/C&P
c) Address:	Ottawa, Ontario	Hull, Quebec
d) Phone Number:	(819) 998-8839	(819) 953-1390

5. Project Objective(s):

To optimize the use of depleting renewable and non-renewable resources by encouraging increased recycling of hazardous waste materials in Canada.

6. Project Accomplishment(s):

a) Used-oil code of practice and background study was completed and printed in the Canadian Council of Environment Ministers (CCME) Series.
b) Bio-medical waste code of practice was developed.

7. Publications/Papers/Reports in 1989-90:

Environment Canada. *Codes of Practice and Background Report*, CCME report series.

Environment Canada. *Draft Codes of Practice on Bio-medical Waste Management.*

8. Proposed PERD Resources: $0K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	42.00	0.00	0.00	0.00	42.00	0.00
EC	0.00	0.00	67.20	1.20	0.00	67.20	1.20
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	42.00	67.20	1.20	0.00	109.20	1.20

1. Title: National Incinerator Testing and Evaluation Program (NITEP)

2. Project #: 12203

3. TASK 1 - ENERGY EFFICIENCY
PROGRAM 1.2 - INDUSTRY
SUBPROGRAM 1.2.2 - WASTE RECOVERY TECHNOLOGY

4. Project Management:
a) Project Manager(s): Abe Finkelstein
b) Service: EC/C&P
c) Address: Ottawa, Ontario
d) Phone Number: (613) 998-8830

5. Project Objective(s):

NITEP is designed to address a number of environmental and technical issues related to the incineration of municipal solid waste (MSW). In particular, it has been recognized that unless MSW incinerators are properly designed and operated the emissions of concern in flue gases and fly ash may be substantial. The program's five year objective is to assess the most prominent incinerator technologies and provide guidance to operators to ensure designs comply with the latest environmental standards.

6. Project Accomplishment(s):

The field testing portion of the fourth and final energy-from-waste facility under NITEP was completed. This project is a jointly sponsored program with the United States Environmental Protection Agency (U.S. EPA) who co-funded this work. The facility tested is a third generation state-of-the-art refuse derived fuel (RDF) energy-from-waste facility, the 2000 ton/day Mid-Connecticut Project, in Hartford, Connecticut. Over 60 megawatts of electricity are generated at this facility when burning RDF. The test program completed was the most extensive evaluation ever undertaken of an incinerator technology and will cost in excess of two million dollars. Test results indicated that proper operation can have a significant impact on the improved stability of the system. Upon assessment of the data obtained at this facility, it was evident that the test unit achieved some of the highest removal efficiencies for organics such as dioxins and furans, and particulate and heavy metals such as mercury, than any other facility in North America.

Environment Canada and the U.S. EPA co-sponsored a very successful *International Conference on Municipal Waste Combustion* in Hollywood, Florida in April 1989. Major participants included the World Health Organization (WHO), the American Society of Mechanical Engineers (ASME), and the Air and Waste Management Association (AWMA). Over 640 delegates from 21 countries around the world participated. The conference provided an excellent forum for the transfer and exchange of information on technical, economic, regulatory, and social issues related to municipal waste combustion and ash residue management.

7. Publications/Papers/Reports in 1989-90:

Environment Canada. *Operating and Emission Guidelines for Municipal Solid Waste Incinerators*, published under the auspices of the Canadian Council of Ministers of the Environment (CCME). The guidelines and supporting documentation were published in June 1989 (Report CCREM-TS/WM-TRE003).

Environment Canada (1989). *International Conference on Municipal Waste Combustion*, conference proceedings.

8. Proposed PERD Resources: $300K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	300.00	0.00	0.00	0.00	0.00	300.00	0.00
EC	907.00	50.00	84.00	1.50	0.00	1,041.00	1.50
OTHERS: US EPA/ EC Fund	0.00	557.00	0.00	0.00	0.00	557.00	0.00
TOTAL	1,207.00	607.00	84.00	1.50	0.00	1,898.00	1.50

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Alliance Technologies	U.S.A.		0.00
TOTAL CONTRACTS			0.00

1. Title: Energy Conservation through the Optimization of Sludge Processing Systems

2. Project #: 12204

3. TASK 1 - ENERGY EFFICIENCY
PROGRAM 1.2 - INDUSTRY
SUBPROGRAM 1.2.2 - WASTE RECOVERY TECHNOLOGY

4. Project Management:
a) Project Manager(s): Herb W. Campbell
b) Service: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4717

5. Project Objective(s):

To develop a framework for evaluating the impact of sludge management systems on energy usage.

6. Project Accomplishment(s):

a) Upgrading of sludge processing facility at Banff.

b) Identification of bottlenecks within sludge processing system. Commissioning and preliminary optimization of polymer system for belt press dewatering.

7. Proposed PERD Resources: $0K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	27.00	0.00	0.00	0.00	27.00	0.00
EC	0.00	0.00	17.00	0.30	0.00	17.00	0.30
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	27.00	17.00	0.30	0.00	44.00	0.30

1. Title: Assessment of Sludge Incineration at a Pulp Mill Power Boiler

2. Project #: 12305

3. TASK 1 - ENERGY EFFICIENCY
PROGRAM 1.2 - INDUSTRY
SUBPROGRAM 1.2.3 - PROCESS TECHNOLOGY

4. Project Management:
a) Project Manager(s): Jim Haskill
b) Service: EC/C&P
c) Address: Hull, Quebec
d) Phone Number: (613) 997-3714

5. Project Objective(s):

To develop a treatment technology for the dewatering of pulp and paper "hot oil" sludges.

6. Project Accomplishment(s):

An experimental apparatus was built to carry out batch drying tests of sludge suspended in oils at temperatures up to 150°C and separation of the sludges from the oil by filtration essentially at the drying temperature. The tests were carried out with newsprint and kraft mill sludges using Bunker C oil and tall oil as drying media. There was a clear interrelationship between the oil content of the product and the residual water content. Pruduct oil contents were higher at lower residual water in the dried product. An environmental impact study on the total mill effluent was assessed by carring out a series of analitical tests and toxicity testing.

7. Publications/Papers/Reports in 1989-90:

Azarniouch, M.K. (1989). *Disposal of Pulp and Paper Mill Sludges*, report prepared by Pulp and Paper Research Institute of Canada for Energy, Mines and Resources.

8. Proposed PERD Resources: $131K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	17.00	0.00	0.00	0.00	17.00	0.00
EC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHERS: EMR[1]	0.00	0.00	16.80	0.30	0.00	16.80	0.30
TOTAL	0.00	17.00	16.80	0.30	0.00	33.80	0.30

[1] Energy, Mines and Resources

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Pulp and Paper Research Institute of Canad	Quebec	KE 144-7-6224	0.00
TOTAL CONTRACTS			0.00

TASK 2

COAL

Energy R&D Program
PERD Task 2 Expenditure Summary

Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)															
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
22102	Pilot Wastewater Treat. - Surface Coal Mining	45	0.0	61	23	0	0	0.0	84	0	1	0	3	0.2	4	0.2	10	0.4	98
22103	Coarse Coal Refuse Management	25	0.0	25	0	0	0	0.0	25	1	0	0	6	0.1	7	0.1	7	0.2	39
22104	FBC Technology Pollution Assessment	218	1.0	123	38	0	57	1.0	218	0	0	0	6	0.1	6	0.0	10	1.1	234
22105	Advance Coal Comb./ Prep. Tech./Env. Imp.	290	0.0	244	26	0	0	0.0	270	23	0	0	22	0.4	45	0.0	260	0.4	575
22106	Regional Scale Meteor. Control Systems	70	0.0	70	0	0	0	0.0	70	23	0	0	34	0.6	57	0.0	20	0.6	147
22107	R&D Coordination/ Workshops	20	0.0	0	20	0	0	0.0	20	0	0	0	0	0.0	0	0.0	0	0.0	20
22108	Sampling, Anal. Meth. of Coal Dust in Matrix	0	0.0	0	0	0	0	0.0	0	0	0	0	5	0.1	5	0.0	30	0.1	35
TASK2	Coal	668	1.0	523	107	0	57	1.0	687	47	1	0	76	1.5	124	0.3	337	2.8	1,148

1. Title: Environmental Protection Criteria Coal Mining and Processing

2. Project #: 22102

3. TASK 2 - COAL
PROGRAM 2.2 - ENVIRONMENT

4. Project Management:
a) Project Manager(s): William B. Blakeman
b) Service: EC/C&P
c) Address: Hull, Quebec
d) Phone Number: (819) 953-1105

5. Project Objective(s):

a) To quantify the removal of nutrients from coal mine wastewater passing through a wetland.

b) To quantify the contribution of the plants to overall nitrogen and phosphorous removal.

c) To investigate the effects of water retention time on treatment performance.

d) To develop design criteria for the construction of a full-scale wetland systems for coal mine wastewater treatment.

6. Project Accomplishment(s):

An 800 m^3 experimental wetland was constructed within a natural wetland at Quinsam Coal Ltd.'s mine near Campbell River on Vancouver Island, British Columbia. This was Year 2 in a three-year pilot study on the use of engineered wetlands for treating nitrate enriched coal mine wastewater.

Water, soil and vegetation samples were collected for chemical analysis. Water samples were collected from March, 1989 to March, 1990.

The results indicate that influent nitrate (NO_2-N) concentrations of up to 118. mg/L can be reduced to 0.005 to 11.3 mg/L. Nitrogen mass removal over the period (data from March 15 to November 6, 1989) was 96%, representing an average removal rate of 0.152 g-N/m^2/d. Total nitrogen removal exceeded 90% from March through September. Ammonia (NH_3-N) and nitrite (NO_3-N) concentrations tended to increase through the wetland, with maximum effluent concentrations of up to 0.91 mg NH_3-N/L and 0.09 mg NO_3-N/L being produced.

Phosphorous (P) concentrations were more variable than nitrogen concentrations. Mass removal of phosphorous during the study period was approximately 48%, representing an average removal rate of 0.023 mg-P/m^2/d. Maximum phosphorous removal occurred in May, the peak period of vegetation growth.

7. Publications/Papers/Reports in 89-90:

Environment Canada (1989). *Evaluation of Wetlands for Nitrogen Removal from Coal Mine Wastewater: Pilot Scale Annual Report - Year 1*, Environment Canada Manuscript Series.

Environment Canada (in press). *Evaluation of Wetlands for Nutrient Removal from Coal Mine Wastewater: Pilot Scale Annual Report - Year 2*, Environment Canada Manuscript Series.

8. Proposed PERD Resources: $45K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAP.	TOTAL L	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	61.20	22.80	0.00	0.00	0.00	84.00	0.00
EC	0.00	1.00	3.00	0.15	0.00	4.00	0.15
OTHERS: Quinsam Coal	0.00	3.00	7.00	0.20	0.00	10.00	0.20
TOTAL	61.20	26.80	10.00	0.35	0.00	98.00	0.35

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Norecol Environmental Consultants	B.C.		0.00
TOTAL CONTRACTS			0.00

1. Title: Coarse Coal Refuse Management

2. Project #: 22103

3. **TASK** **2 - COAL**
PROGRAM 2.2 - ENVIRONMENT

4. Project Management:
a) Project Manager(s): Roy Parker
b) Department: EC/C&P/Atlantic Region
c) Address: Dartmouth, Nova Scotia
d) Phone Number: (902) 426-8564

5. Project Objective(s):

To identify existing methods of coarse coal refuse disposal and assess practical and cost-effective methods and technologies used by the coal and mineral industries to prevent, reduce or treat acid generation in preparation plant solid wastes.

6. Project Accomplishment(s):

Contract study completed and final report received. Steering Committee for project has been established with representation from Environment Canada, the Province of Nova Scotia and industry. A total of 9 candidate coarse coal waste management techniques have been assessed. In the majority of the techniques, placement and compaction to a specified engineering design, possibly combined with a bottom seal and cover, will provide the optimum management approach. However, the other techniques may provide attrative options in certain specific locations.

7. Publications/Papers/Reports in 89-90:

Nolan, Davis and Associates, (1990). *Identification and assessment of methods and technologies to improve management of coal coarse rock waste*, report prepared for Environment Canada's Atlantic Region, 72 p.

8. Proposed PERD Resources: $25K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	25.00	0.00	0.00	0.00	0.00	25.00	0.00
EC	1.00	0.00	6.60	0.10	0.00	7.60	0.10
OTHERS:							
N.S. Gov[1]	0.00	0.50	2.80	0.05	0.00	3.30	0.05
Industry	0.00	0.50	2.80	0.05	0.00	3.30	0.05
TOTAL	25.00	2.00	9.40	0.20	0.00	39.20	0.20

[1] Nova Scotia Government

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Nolan, Davis & Associates Ltd.	N.S.		25.00
TOTAL CONTRACTS			25.00

1. Title: Fluidized Bed Combustion (FBC) Technology Assessment

2. Project #: 22104

3. TASK 2 - COAL
   PROGRAM 2.2 - ENVIRONMENT

4. Project Management:
   a) Project Manager(s): Geoff Ross
   b) Department: EC/C&P
   c) Address: Hull, Quebec
   d) Phone Number: (819) 997-1222

5. Project Objective(s):

   a) Conduct long-term monitoring of Chatham, New Brunswick FBC waste disposal test cells.

   b) Assess and demonstrate options for the utilization of FBC waste residues.

   c) Publish/distribute reports from Chatham FBC studies.

6. Project Accomplishment(s):

   a) Analysis of cores from Chatham FBC test cells showed a general deterioration in cell integrity over the long term (733 days), indicating a need for further attention to disposal procedures.

   b) Pilot testing of roller-compacted concrete (RCC) made from FBC waste residue and pulverized coal fly-ash show an early strength (1200 psi) so promising that demonstration of its use in road base is planned for 1990/91.

   A promising method of pelletizing FBC residue has been developed at pilot scale. The feasibility and advantages of applying this process at full-scale will be investigated in 1990/91. Pelletization has many potential benefits related to the handling, storage, disposal and utilization of FBC residue.

   In the Environmental Assessment Report for the Point Aconi FBC Generating Station, December 1989, Nova Scotia Power has used information from PERD - funded research as the basis for their proposed design of the FBC ash disposal facility. Also, recognition of Canadian R&D in FBC (to which PERD project 22104 has contributed) has influenced the decision to hold the Eleventh International Conference on FBC in Canada, 1991. This will be the first time the conference has been held outside the U.S.A.

7. Publications/Papers/Reports in 89-90:

Ross, G.G., E.J. Anthony, R.K. Kissel and C.C. Doiron (1989). *Field Demonstration of Fluidized Bed Combustion Residue Management*, presented at the Tenth International Conference on Fluidized Bed Combustion, San Francisco, May 1, 1989.

Anthony, E.J., G.G. Ross, et al. (1989). *Characterization of Solid Wastes from Circulating Fluidized Bed Combustion*, presented at the Tenth International Conference on Fluidized Bed Combustion, San Francisco, May 1, 1989.

Dearborn Environmental Consulting Group (in press). *Technical Options for the Disposal of Circulating Fluidized Bed Combustion Solid Wastes*, report prepared for Environment Canada.

8. Proposed PERD Resources: $218K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	122.60	38.50	57.00	1.00	0.00	218.10	1.00
EC	0.00	0.00	5.60	0.10	0.00	5.60	0.10
OTHERS: EMR[1]	10.00	0.00	0.00	0.00	0.00	10.00	0.00
TOTAL	132.60	38.50	62.60	1.10	0.00	233.70	1.10

[1] Energy, Mines and Resources

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Dearborn Environmental Consulting	Ontario		132.60
TOTAL CONTRACTS			132.60

1. Title: Advanced Coal Combustion Emissions Control

2. Project #: 22105

3. TASK 2 - COAL
PROGRAM 2.2 - ENVIRONMENT

4. Project Management
a) Project Manager(s): Pat G. Finlay
b) Department: EC/C&P
c) Address: Hull, Quebec
d) Phone Number: (819) 953-1126

5. Project Objective(s):

a) To assist with the development of cost-effective emission control technologies.

b) To assess the environmental implications of advanced coal combustion technologies.

c) To provide government and industry with technicalinformation to develop emission control strategies and standards.

6. Project Accomplishment(s):

a) In support of the development of regulations and guidelines to control emissions from boilers, the Federal Industrial Boiler Emission Control (FIBEC) demonstration program was initiated. Achievements include:
   i) Demonstration of California Nitrogen Oxide (NO_x) emissions standards for the first time in Canada for a boiler retrofitted with Flue Gas Recirculation (FGR) at the Atmospheric Environment Service (AES), Downsview, Ontario.
   ii) Demonstration of low cost, simple and accurate portable NO_x emission monitors which are to be used as a Standard Reference Method in further work.
   iii) Development of a detailed plan to demonstrate, for coal-fired boilers, a novel Canadian Selective Catalytic Reduction (SCR) technology developed by Atomic Energy of Canada Ltd. (AECL)

b) Updating "CANSIM" utility computer simulation model for input to Canadian Council of Environment Ministers NO_x/Volatile Organic Compounds (VOC) Management Plan.

c) Analyzing the cost and effectiveness of options for controlling carbon dioxide (CO_2) flue gas emissions from Canadian power plants.

d) Co-sponsoring with the Canadian Electrical Association a seminar on Integrated Coal Gasification Combined Cycle (ICGCC) for power plants and a study of advanced limestone Flue Gas Desulphurization (FGD).

7. Publications/Papers/Reports in 89-90:

Sypher: Mueller International Inc. (1990). *Federal Industrial Boiler Emission Control Program,* report prepared for Environment Canada.

Radian Corporation and Monserco Ltd. (1990). *Cost Analysis of Controlling CO_2 Flue Gas Emissions from Canadian Power Utilities,* report prepared for Environment Canada.

Monserco Ltd.(1989). *Acid Gas Emissions Derived from the Canadian Utilities Simulation Code for All of Canada,* report prepared for Environment Canada.

Monserco Ltd. (1990). *Users Manual for Version 3.0 of CANSIM,* report prepared for Environment Canada.

8. Proposed PERD Resources: $290K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	244.10	26.20	0.00	0.00	0.00	270.30	0.00
EC	23.30	0.00	22.40	0.40	0.00	45.70	0.40
OTHERS:							
EMR[1]	100.00	0.00	0.00	0.00	0.00	100.00	0.00
DND[2]	35.00	0.00	0.00	0.00	10.00	45.00	0.00
CEA[3]	125.00	0.00	0.00	0.00	0.00	125.00	0.00
TOTAL	527.40	26.20	22.40	0.40	10.00	586.00	0.40

[1] Energy, Mines and Resources
[2] Department of National Defence
[3] Canadian Electrical Association

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Muller International	Ontario		200.00
Monserco Ltd.	Ontario		42.40
Stone & Webster Canada Ltd.	Ontario		25.00
TOTAL CONTRACTS			267.40

1. Title: Regional Scale Meteorological Systems

2. Project #: 22106

3. TASK 2 - COAL
   PROGRAM 2.2 - ENVIRONMENT

4. Project Management:

a) Project Manager(s):	A. O'Toole	Keith J. Puckett
b) Service:	EC/AES	EC/AES
c) Address:	Downsview, Ontario	Downsview, Ontario
d) Phone Number:	(416) 739-4705	(416) 739-4836

5. **Project Objective(s):**

Completion of model runs (diagnostic/prognostic) for the 7 episodes being examined.

6. **Project Accomplishment(s):**

a) All diagnostic and prognostic model runs for the episodes have been completed.
b) Analysis and final report is due in March 1992.

7. Proposed PERD Resources: $70K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	70.00	0.00	0.00	0.00	0.00	70.00	0.00
EC	23.00	0.00	34.10	0.55	0.00	57.10	0.55
OTHERS:OME	0.00	20.00	0.00	0.00	0.00	20.00	0.00
TOTAL	93.00	20.00	34.10	0.55	0.00	147.10	0.55

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Ortech International	Ontario	KM171-9-7497/01-XSE	98.00
ARM Consultants	Ontario	KM171-9-7674/01-XAJ	15.00
TOTAL CONTRACTS			113.00

1. Title: Sampling and Analysis for Coal in a Particulate Matrix

2. Project #: 22108

3. TASK 2 - COAL
PROGRAM 2.2 - ENVIRONMENT

4. Project Management:
a) Program Manager(s): David Poon
b) Service: EC/C&P/Pacific & Yukon Region
c) Address: West Vancouver, B.C.
d) Phone Number: (604) 666-2862

5. Project Objective(s):

The development of sampling and analytical methods for the difficult determination of coal particles in a particulate matrix is needed in order to be able to quantitatively measure air quality impacts of coal transportation. The objectives of the project is to:

a) Set-up of analytical apparatus for pyrolysis and gas chromatography (GC) testing.

b) Determination of product yield from above method.

c) Recommendation of method development work for 1990/91.

6. Project Accomplishment(s):

a) Pyrolysis/GC analytical apparatus has been set-up and tested.

b) Product yield with current methodology is limited to 4-5%.

c) Recommendation of three approaches to develop the method in 1990/91.

7. Publications/Papers/Reports in 1989-90:

Espin, G., and A. Morrison (1990). *Development of a Sampling Technique for Airborne Coal Dust and Analytical Method for Coal in a Particulate Matrix,* interim report prepared for Environment Canada.

8. Proposed PERD Resources: $0K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC	0.00	0.00	5.40	0.10	0.00	5.40	0.10
OTHERS:							
EMR[1]	0.00	15.00	0.00	0.00	0.00	15.00	0.00
BC/MOE[2]	0.00	15.00	0.00	0.00	0.00	15.00	0.00
TOTAL	0.00	30.00	5.40	0.10	0.00	35.40	0.10

[1] Energy, Mines and Resources
[2] British Columbia Ministry of the Environment

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
B.C. Research	B.C.		0.00
TOTAL CONTRACTS			0.00

TASK 4

RENEWABLE ENERGY AND GENERIC ENVIRONMENT

Energy R&D Program
PERD Task 4 Expenditure Summary

Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)															
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
41101	Hydrologic Design Methodology	50	0.0	43	7	0	0	0.0	50	0	0	8	59	1.1	67	0.0	0	1.1	117
42102	Design Information and Measurement Technology	75	0.0	39	18	18	0	0.0	75	0	2	2	24	0.4	28	0.0	10	0.4	113
45403	Anaerobic Digestion	150	0.0	95	0	55	0	0.0	150	0	0	30	189	3.5	219	0.0	255	3.5	624
46101	Resource Assessment	47	0.0	8	33	6	0	0.0	47	0	0	0	44	0.7	44	0.0	0	0.7	91
48103	Carbon Dioxide Advisor	97	1.0	17	14	0	66	1.0	97	0	0	0	39	1.1	39	0.0	0	2.1	136
48107	RAG's Measurement	150	0.0	48	27	75	0	0.0	150	0	17	4	56	0.7	77	0.0	0	0.7	227
48108	Departmental R&D Coordination	182	2.0	33	3	14	131	2.0	181	0	0	0	10	0.4	10	0.0	0	2.4	191
48110	Groundwater Treatment	261	0.0	130	0	80	0	0.0	210	0	233	0	108	2.0	341	0.0	0	2.0	551
48111	ETSAP Project	34	0.0	34	0	0	0	0.0	34	21	0	0	50	0.7	71	0.0	1539	0.7	1,644
48113	Carbon Cycle Climate Modelling	100	0.0	43	47	10	0	0.0	100	0	0	0	20	0.4	20	0.0	0	0.4	120
TASK4	Renewable Energy and Generic Environment	1,146	3.0	490	149	258	197	3.0	1,094	21	252	44	599	11.0	916	0.0	1,804	14.0	3,814

1. Title: Hydrologic Design Methodology for Ungauged Small-Scale Hydro

2. Project #: 41101

3. **TASK** **4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT**
   PROGRAM 4.1 - HYDRAULICS
   SUBPROGRAM 4.1.1 - SMALL SCALE HYDRO

4. Project Management:
   a) Project Manager(s): Eon T. Park
   b) Service: EC/C&P
   c) Address: Hull, Quebec
   d) Phone Number: (819) 997-2308

5. Project Objective(s):

   a) To develop a Geographic Information System (GIS) to extract physiographic parameters directly from digitized map information by use of the enhanced spatial analysis (SPAN) software.

   b) To conduct a pilot application of the developed GIS system to a couple of selected sub-regions in Quebec.

   c) To organize a technical seminar to promote the use of the developed models.

6. Project Accomplishment(s):

   a) Enhanced GIS (SPAN) for physiographic parameter extraction.

   b) Technical report on determining the physiographic parameters for hydrologic modelling using a SPANS geographic information system (pilot application for the GIS software).

   c) A technical seminar on *Hydrology for Ungauged Sites.*

7. Publications/Papers/Reports in 1989-90:

M. Landreville, GIS Consultant (1990). *Determining Physiographic Parameters for Hydrologic Modelling Using a SPANS Geographic Information System,* prepared for Environment Canada.

TYDAC Co. (1990). *Spatial Analysis System (SPANS) version 4.3 (Installation Concepts and Tutorials; Reference Manual and Appendices, and Digitizing Tutorial and Reference),* report prepared for Environment Canada.

8. Proposed PERD Resources: $50K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	43.00	7.00	0.00	0.00	0.00	50.00	0.00
EC	0.00	0.00	59.40	1.10	8.00	67.40	1.10
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	43.00	7.00	59.40	1.10	8.00	117.40	1.10

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
TYDEC Co.	Ontario		0.00
M. Landreville - GIS Consultants	Ontario		0.00
Charles Howard & Associates Ltd.	B.C.		0.00
TOTAL CONTRACTS			0.00

1. Title: Design Information & Measurement Technology for Solar Energy

2. Project #: 42102

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.2 - ACTIVE SOLAR

4. Project Management:

a) Project Manager(s):	Mel O. Berry	David Wardle
b) Service:	EC/AES	EC/AES
c) Address:	Downsview, Ontario	Downsview, Ontario
d) Phone Number:	(416) 739-4370	(416) 739-4632

5. Project Objective(s):

The spectral measurement and climatology of solar radiation is important for the more recent technologies such as super windows and daylighting in buildings. Addtional detailed measurements and modelling were identified for the arctic radiation climatology and near and thermal infrared radiation. Objectives include

a) Printing of International Energy Agency (IEA) Task IX, Subtask (b) final reports.

b) Completion of IEA Subtask (c).

c) Continue development of International Standard Association (ISO) pyranometry standards, and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) design information.

d) Provision of environmental design information for daylighting.

6. Project Accomplishment(s):

a) IEA Solar Heating and Cooling Program Task IX Subtasks (d), (e), (f) continued. Subtask (c) report in preparation.

b) ISO solar radiation instrument characterization experiments have been continued, yielding results different to older U.S. results, making further experimentation essential.

c) Capability to provide hourly estimates of natural illumination on a horizontal and tilted surfaces added to the AES solar radiation model.

7. Publications/Papers/Reports in 1989-90:

McArthur, L.B., (1989). *Illuminance Modelling for Canada* (a review and evaluation of computer models which specify hourly amounts of natural illumination on horizontal and surfaces of prescribed orientation); final draft report to the Atmospheric Environment Service is under review.

8. Proposed PERD Resources: $75K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	39.00	18.10	0.00	0.00	17.70	74.80	0.00
EC	0.00	2.00	24.00	0.44	2.00	28.00	0.44
OTHERS: PWC[1]	0.00	10.00	0.00	0.00	0.00	10.00	0.00
TOTAL	39.00	30.10	24.00	0.44	19.70	112.80	0.44

[1] Public Works Canada

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Arvids Silis	Ontario		0.00
Solar Instrumentation Research Ltd.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Methane Production from Industrial Wastewaters

2. Project #: 45403

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.5 - BIOENERGY
   SUBPROGRAM 4.5.4 - ANAEROBIC DIGESTION

4. Project Management:
   a) Project Manager(s): Eric R. Hall
   b) Service: EC/C&P
   c) Address: Wastewater Technology Centre (WTC)
      Burlington, Ontario
   d) Phone Number: (416) 336-4715

5. Project Objective(s):

   a) Select and verify a process model for an anaerobic process control algorithm.

   b) Assess fate of resin acids of thermo-mechanical pulping (TMP)/chemithermal mechanical pulping (CTMP) wastewaters in anaerobic systems.

   c) Characterization and anaerobic screening of CTMP wastewaters.

   d) Provide technical support to Energy, Mines and Resources (EMR), Industry, Science and Technology (ISTC), SNC Research Corp., Zenon Environmental Services Inc, pulp and paper companies, and universities (Waterloo, McMaster, UBC) for development and demonstration of anaerobic treatment at full-scale.

6. Project Accomplishment(s):

   a) Anaerobic process model selected to use in process control algorithm.

   b) Experimental work on fate of TMP/CTMP wastewater toxics completed. Report under preparation for delivery in 1990/91.

   c) Full scale start-up and demonstration of anaerobic screening technology for pulp and paper wastewater at Consolidated-Bathurst, Bathurst, N.B., Lake Utopia Paper, St. George, N.B., Quesnel River Pulp, Quesnel, B.C., McCain Foods, Florenceville, N.B., Cavendish Farms, New Annan, P.E.I. Draft final report received from Metro Halifax with final version to be delivered in 1990/91.

   d) Continued co-operative program with Ontario Ministry of Environment on treatment technology development for bleach kraft mill effluents for federal and Ontario's Municipal Industrial Sewage Abatement (MISA) regulatory initiatives.

e) Report completed on joint Paprican-WTC pilot program at Spruce Falls Power & Paper Co. Ltd., Kapuskasing, Ontario.

f) Industry-government workshop sponsored on *CTMP Wastewater Treatment*, Vancouver, April 5-7, 1989.

g) Construction of full-scale anaerobic treatment system completed at MacMillan Bloedel Sturgeon Falls Ontario Division. This program began with a 1986 WTC pilot study.

h) Agreement reached with SNC Reserch Corp. and Zenon Environmental Services Inc. to develop membrane anaerobic bioreactor technologies at WTC.

i) Report prepared on the use of commercial biocatalytic additives for high rate anaerobic reactor start-up.

j) WTC staff participated in organization of the 6th International Symposium on Anaerobic Digestion, Sao Paulo, May 1991.

7. Publications/Papers/Reports in 1989-90:

Hall, E.R., J. Fraser, S. Garden and L.-A. Cornacchio, (1989). *Organo-chlorine Discharges in Wastewaters from Kraft Mill Bleach Plants*, Pulp & Paper Canada, 90(11):68-72.

Jones, R.M. and E.R. Hall, (1989). *Dynamic Modelling of a High Rate Anaerobic Treatment Process*, Environ. Technol. Lett., 10:p 551-566.

Hall, E.R., S. Skog and J.D. Goodin, (1989). *Investigation of a Biocatalytic Additive to Improve the Start-up of High Rate Anaerobic Reactors*, unpublished report WTC-BIO-03-1989, Wastewater Technology Centre, Burlington, Ontario.

Schnell, A., J. Dorica and S. Prahacs, (1989). *Pilot Scale Effluent Treatment Studies at the Spruce Falls Power & Paper Co. Ltd.*, Paprican Project 6268, Pointe Claire, Quebec.

Schnell, A., J. Dorica, M. Ashikawa, G. Munnoch and E.R. Hall, (1990). *Anaerobic and Aerobic Pilot-scale Effluent Detoxification Studies at an Integrated Newsprint Mill*, paper presented at 76th Annual Meeting Technical Section, Montreal, January 29-31, 1990, Canadian Pulp and Paper Association.

8. Proposed PERD Resources: $150K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	95.00	0.00	0.00	0.00	55.00	150.00	0.00
EC	0.00	0.00	189.00	3.50	30.00	219.00	3.50
OTHERS:							
ISTC[1]	0.00	55.00	0.00	0.00	50.00	105.00	0.00
Ont. MOE[2]	0.00	150.00	0.00	0.00	0.00	150.00	0.00
TOTAL	95.00	205.00	189.00	3.50	135.00	624.00	3.50

[1] Industry, Science and Technology Canada
[2] Ontario Ministry of the Environment

13. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
L.-A. Cornacchio	Ontario		0.00
Beak Consultants	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Atmospheric Aerodynamics

2. Project #: 46101

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.6 - WIND
   SUBPROGRAM 4.6.1 - ATMOSPHERIC AERODYNAMICS

4. Project Management:

a) Project Manager(s):	Mel O. Berry	Hans C. Martin
b) Service:	EC/AES	EC/AES
c) Address:	Downsview, Ontario	Downsview, Ontario
d) Phone Number:	(416) 739-4370	(416) 739-4471

5. Project Objective(s):

Support to standards agencies: Canadian Standard Association (CSA) F428 wind energy conversion system (WECS) Siting Guidelines; International Energy Agency (IEA) Handbook on Site Assessment for WECS (Figs.1,2). The Handbook considers the assessment of consumer demand, wind resource, environment factors, wind-diesel systems and the economics of decentralised applications.

6. Project Accomplishment(s):

a) Improvements were added to MS-MICRO, the IBM PC program developed to model wind flow in complex terrain, to allow enhanced graphical output. Further development occurred on MSFD, a more general model than MS-MICRO. For now, it will remain on the AES CRAY mainframe due to computational requirements.

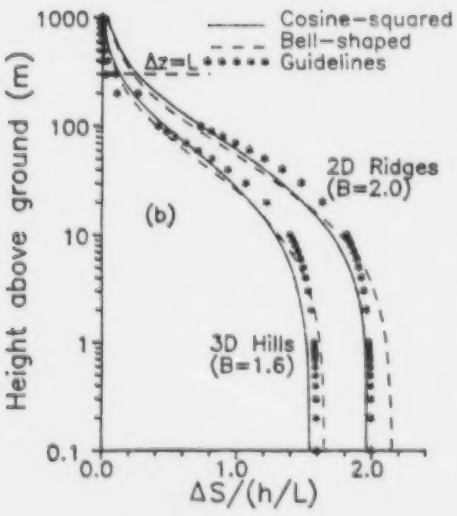


Figure 1: Flow over idealised hills calculated using the Guidelines and the MS3DJH model. (a) Hill cross-sections. (b) Speed at summit.

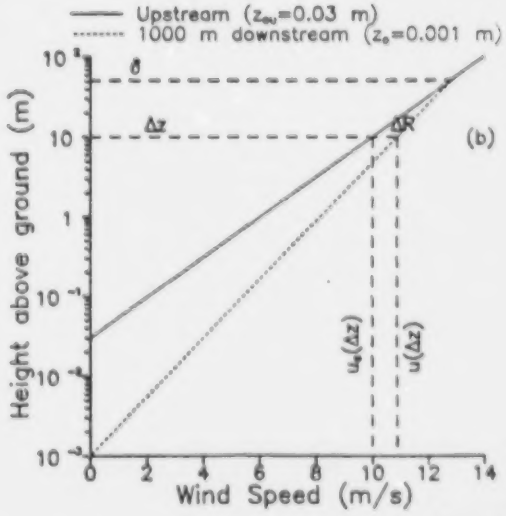


Figure 2: Flow over a rough-to-smooth change in surface roughness. (a) Internal boundary-layer height. (b) Wind speed profiles.

b) AES chapter for the IEA Annex VIII Wind-Diesel Guidebook was completed. The draft manuscript will be presented for approval to the IEA Executive Committee at its next meeting. The basic approach taken is an initial simple technique in order to prioritize sites and a further measurement program and/or application of numerical models in order to arrive at a final site selection.

7. Publications/Papers/Reports in 1989-90:

Walmsley, J.L., P.A. Taylor and J.R. Salmon, (1989). *Simple Guidelines for Estimating Wind Speed Variations due to Small-Scale Topographic Features - An Update.* Climatol. Bull., 23(1), 3-14.

Walmsley, J.L., I. Troen, D.P. Lalas and P.J. Mason, (1989). *An Intercomparison of Models for Wind Flow in Complex Terrain and Data from the Blashaval Experiment.* Proc., European Wind Energy Conference, 1989, Glasgow, Scotland, 2, 853-857.

Walmsley, J.L., (1989). *The International Energy Agency Handbook on Decentralised WECS Siting: Wind Resource Assessment.* Proc., European Wind Energy Conference, 1989, Glasgow, Scotland, 2, 963-967.

Walmsley, J.L., and J.R. Salmon, (1989). *MS-Micro/2 User's Manual.* Second Edition. Rep. Can. Climate Centre, Downsview, Ontario, 115 pp.

Walmsley, J.L., (1989). *The Physics of Wind,* presentation given at the Wind Energy Workshop, sponsored by Energy, Mines & Resources Canada, Charlottetown, P.E.I.

Walmsley, J.L., (1989). *Wind Flow in Complex Terrain,* lecture given at Trent University, Peterborough, Ontario.

Walmsley, J.L., and J. Padro, (1990). *Shear Stress Results from a Mixed Spectral Finite-Difference Model: Application to the Askervein Hill Project Data.* Boundary-Layer Meteorol, 51, 169-177.

Walmsley, J.L., I. Troen, D.P. Lalas and P.J. Mason, (1990). *Surface-Layer Flow in Complex Terrain: Comparison of Models and Full-Scale Observations.* Boundary-Layer Meteorol.

Walmsley, J.L., (1990). *Wind Resource Assessment,* Chapter 4 (56 pp) of Wind Diesel Guidebook: Siting Technology and Implementation, International Energy Agency, Brussels.

Walmsley, J.L., (1990). *Climatic Conditions,* Section 5.1.2 (2 pp) of Wind-Diesel Guidebook: Siting Technology and Implementation, International Energy Agency, Brussels, in press.

Roy, S., L. Lefaivre, et E. Larocque, (1989). *Réseau à la mésoéchelle Québec 84 - Guide de l'usage,* Division des services scientifiques, SEA - Région du Québec, 28 pages + 5 annexes.

Roy, S., M. Jean, et M. Hardy, (1990). *Traitement préliminaire des données en altitude - Québec 84,* Division des services scientifiques, SEA - Région du Québec.

8. Proposed PERD Resources: $47K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	8.0	33.00	0.00	0.00	6.00	47.00	0.00
EC	0.00	0.00	44.00	0.72	0.00	44.00	0.72
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	8.00	33.00	44.00	0.72	6.00	91.00	0.72

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Université de Sherbrooke	Quebec		0.00
TOTAL CONTRACTS			0.00

1. Title: Carbon Dioxide Advisor

2. Project #: 48103

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:
   a) Project Manager(s): Henry G. Hengeveld
   b) Service: EC/AES
   c) Address: Downsview, Ontario
   d) Phone Number: (416) 739-4323

5. Project Objective(s):

To develop and make available to government specialized information on the possibilities of carbon dioxide (CO_2)-induced climate changes and resulting impacts as they relate to Canadian concerns about energy supply and demand.

The project is focused on developing and maintaining an up-to-date understanding of available scientific knowledge pertaining to energy related emission of greenhouse gases, their natural global cycles, climate change and impacts of climate change; stimulating interest among Canadian scientists in pursuing related research pertinent to Canada; and disseminating new information to government policy makers through quartely newsletters, study reports, seminars and direct advice.

6. Project Accomplishment(s):

a) Review/cataloguing of approximately 500 articles and reports.

b) Preparation and dissemination of one issue of CO_2/Climate Report.

c) Final drafting of State of the Environment (SOE) report on climate change.

d) Presentation of numerous briefings and seminars to a wide variety of audiences.

e) Participation in domestic and international meetings on policy response to climate change.

f) Media interviews.

g) Analysis of Canadian climate trends of last 90 years.

7. Publications/Papers/Reports in 1989-90:

Environment Canada, (1989). *CO_2/Climate Report*, AES periodical publications.

8. Proposed PERD Resources: $97K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	16.70	13.80	66.00	1.00	0.00	96.50	1.00
EC	0.00	0.00	38.50	1.10	0.00	38.50	1.10
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	16.70	13.80	104.50	2.10	0.00	135.00	2.10

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
J.P. Doucet	Ontario	KM111-9-0047	7.50
Lanark House Communications	Ontario	KM111-9-0772	4.20
Friends of the Earth Canada	Ontario	KM048-9-1154	5.00
TOTAL CONTRACTS			16.70

1. Title: Radiatively Active Gases (RAG's) Measurement

2. Project #: 48107

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:
   a) Project Manager(s): Wayne Evans
   b) Service: EC/AES
   c) Address: Downsview, Ontario
   d) Phone Number: (416) 739-4624

5. Project Objective(s):

To develop a system for the detection of atmospheric radiatively active gases (primarily CO_2). The detection of changes in the longwave radiation budget which will relult form atmospheric accumulation of CO_2 or other RAG's will werve as an early warning system for impending climate change.

a) Begin the installation of instrumentation for the observatory.

b) Initiate development of model and the applications for the assessment of the effects of RAG's on climate change.

6. Project Accomplishment(s):

a) AES measurements shows that new experimental evidence support the climate change model predictions of the greenhouse effect. The emission of chlorofluorocarbons (CFC) into the atmosphere by anthropogenic usage has modifeid the long-wave radiation budget of the atmoshphere by ~0.1%.

b) Rebuilt RAG's observatory following tornado damage.

c) Installation of instrumentation (filter spectrometer).

d) Lonch of three payloads "balloon" in co-operation with MOPOL experiments.

7. Publications/Papers/Reports in 1989-90:

Evans, W.F.J., (1988). *A Measurement of the Altitude Variation of Greenhouse Radiation from CFC-12.)*, Nature, vol. 333, pp. 750-752.

8. Proposed PERD Resources: $150K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	48.00	27.00	0.00	0.00	75.00	150.00	0.00
EC	0.00	17.20	56.00	0.70	3.80	77.00	0.70
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	48.00	44.20	56.00	0.70	78.80	227.00	0.70

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Scientific Instrumentation Ltd.	Sask	KM172-9-7484/01-XSE	47.54
TOTAL CONTRACTS			47.54

1. Title: Departmental Energy R&D Program Coordination

2. Project #: 22107/48108/67258

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:

a) Project Manager(s):	Duncan Hardie	Suzanne Roussel
b) Service:	EC/OSA	EC/OSA
c) Address:	Hull, Quebec	Hull, Quebec
d) Phone Number:	(819) 997-7625	(819) 953-5380

5. Project Objective(s):

   a) To plan and coordinate Environment Canada's Energy Research and Development Program.

   b) To liaise with the Office of Energy Research and Development (OERD) for program and financial information.

   c) To provide liaison with other government departments, provincial, university and private sectors in energy related issues.

6. Project Accomplishment(s):

   a) Published and distributed the report A Decade of Achievement: Environment and Energy Research and Development, and Environment Canada Energy Research and Development Programme 1988-89 Annual Report.

   b) Co-sponsored and made an address to the Energy Options and Climate Change Conference organized by the Association of Canadian Universities for Northern Studies (ACUNS).

   c) Co-sponsored workshop on Canadian Continental Shelf Sea Bed Symposium (C^2S^3). The workshop covered the topics of surficial geology, physical oceanography, surficial sediment dynamics, chemical interactions between the sea bed, biological benthic habitats and engineering aspects.

   d) Co-sponsored PERD 6.7 Committee Special Topic Workshop on Tainting in Fish Species and Biochemical Indicators of Pollution held in Ottawa on May 11, 1989.

7. Publications/Papers/Reports in 1989-90:

Environment Canada (1989). *Environment Canada Energy Research of Development Programme: 1988/89 Annual Report.*

Environment Canada (1989). *A Decade of Achievement: Environment and Energy Research & Development*, ISBN 0-662-564 93-6, Cat. No. En 21-78/1989.

Engelhardt, F.R., D. Hardie and R. Bisson, (1989). *Proceedings of the Panel for Energy Research and Development, Task 6.7: Special Topic Workshop on Biochemical Indicators of Pollution and Tainting of Resource Species*, report prepared for PERD Task 6.7 Environment Committee.

8. Proposed PERD Resources: $20K/$182K (2 PY)/$30K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	33.65	52.7	131.30	2.00	14.38	232.03	2.00
EC	0.00	0.00	10.00	0.40	0.00	10.00	0.40
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	33.65	52.70	141.30	2.40	14.38	242.03	2.40

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Maxima Computing	Ontario		3.13
Entra Computer	Ontario		14.38
Turquoise Design	Quebec		6.86
Force	Quebec		4.55
Love Printing	Ontario		19.12
TOTAL CONTRACTS			48.03

1. Title: Demonstration of Groundwater and Soil Treatment Technologies for Problems of the Petroleum Industry

2. Project #: 48110

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:
   a) Project Manager(s): Jim W. Schmidt
   b) Service: EC/C&P
   c) Address: Wastewater Technology Centre, Burlington, Ontario
   d) Phone Number: (416) 336-4541

5. Project Objective(s):

   a) Establish the National Groundwater and Soil Remediation Program (GASReP) cooperatively with industry and government.

   b) Establish joint industry/government research efforts in the priority areas of in-situ bioremediation, soil venting and off-gas treatment, excavate and treat, and pump and treat.

   c) Technology transfer.

6. Project Accomplishment(s):

   a) GASReP has been established with representation from the Canadian Petroleum Products Institute, Canadian Petroleum Association, American Petroleum Institute, United States Environmental Protection Agency, Energy, Mines and Resources, Environment Canada, British Columbia Ministry of the Environment, Alberta Environment, Ontario Ministry of the Environment, Quebec, Prince Edward Island's Department of the Environment, and New Brunswick Department of Municipal Affairs and Environment. Terms of Reference for the committees and draft Guidelines for Proposals have been prepared.

   b) Contracts have been awarded for literature reviews and research scoping studies for in-situ bioremediation, off-gas treatment, in-situ volatilization, excavate and treat; for the degradation of BTX (benzene, toluene and xylene) by denitrifying bacteria; for an R&D site selection and characterization; for R&D into in-situ biological barriers; and for iron pre-treatment studies. Reports of these initiatives will be available in 1990/91.

c) A technology transfer conference was held in May 1989 on Prevention and Treatment of Groundwater and Soil Contamination in Petroleum Exploration and Production. A similar conference for the downstream sector was held in October 1990 in Montreal. A symposium on advanced oxidation processes was held in June 1990 in Toronto.

7. Publications/Papers/Reports in 1989-90:

Environment Canada, (1989). *Prevention and Treatment of Groundwater and Soil Contamination in Petroleum Exploration and Production*, conference proceedings, May 9-11, 1989, Calgary.

Environment Canada, (1990). *Advanced Oxidation Processes for the Treatment of Contaminated Water and Air*, conference proceedings, June 4-5, 1990, Toronto.

Environment Canada, (1990). *Prevention and Treatment of Soil and Groundwater Contamination in the Petroleum Refining and Distribution Industry*, conference proceedings, October 16 - 17, 1990, Montreal.

ORTECH and Droycon, (1990). *In-situ Intercedent Biological Barriers for the Containment and Remediation of Contaminated Groundwater - Phase I, Laboratory Confirmatory Studies*, report prepared for Environment Canada.

Barker, J., (1990). *Site Selection Research*, for Environment Canada.

Intera Kenting, (1990). *Information Search for Current and Innovative Excavate and Treatment Technologies for the Remediation of Hydrocarbon Contaminated Soil*, report prepared for Environment Canada.

CH2M Hill, (1990). *Literature Review and Research Scoping Study for the In-situ Enhancement of the Volatilization of Organic Contaminants in the Unsaturated Zone*, report prepared for Environment Canada.

J. Brewer, Ian Martin Associates, (1990). *Literature Review and Research Scoping Study on the Treatment of Volatile Organic Carbon Compounds in the Off-gas from Contaminated Groundwater and Soil Remediation Technologies*, report prepared for Environment Canada.

University of Waterloo, (1990). *In-situ Cleanup of Aquifers by Employing Denitrifying Bacteria*, report prepared for Environment Canada.

Beak Consultants Ltd., (1990). *Literature Review and Scoping Study for In-situ Bioremediation of Soil and Groundwater*, report prepared for Environment Canada.

8. Proposed PERD Resources: $261K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	130.00	0.00	0.00	0.00	80.00	210.00	0.00
EC	0.00	232.5	108.00	2.00	0.00	340.50	2.00
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	130.00	232.50	108.00	2.00	80.00	550.50	2.00

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Beak Consultants Laboratory Ltd.	Ontario		30.00
CH2M Hill Engineering Ltd.	Ontario		36.00
Droycon Bioconcepts Inc	Sask		45.00
ORTECH International	Ontario		
Intera Kenting	Ontario		30.00
Marbek Resource Consultants Ltd.	Ontario		15.00
Dr. Jim Barker, Univ. of Waterloo	Ontario		29.00
InfoTech	Alberta		5.00
TOTAL CONTRACTS			190.00

1. Title: International Energy Agency Implementing Agreement - Energy Technology Systems Analysis Project (ETSAP)

2. Project #: 48111

3. TASK 4 - RENEWABLE ENERGY & GENERIC ENVIRONMENT
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:

a) Project Manager(s):	John G. Hollins	Philip L. Cohen
b) Service:	EC/OSA	EC/OSA
c) Address:	Hull, Quebec	Hull, Quebec
d) Phone Number:	(819) 994-5167	(819) 997-8812

5. Project Objective(s):

Canada is an active participant in Annex III ETSAP, whose purpose is the development of the MARKAL linear programming model to include environmental factors as well as the traditional economic and energy parameters.

6. Project Accomplishment(s):

Environmental parameters were successfully incorporated into MARKAL by the ten countries that participated in Annex III of ETSAP from 1986 to 1989. Most countries set out at the beginning of Annex III to address acid gases, but four countries also did some preliminary work on carbon dioxide which was contributed to the International Panel on Climate Change (IPCC).

In June and October 1989, ETSAP held workshops on environmental emission control measures for energy systems. The June workshop received national contributions to the final report for Annex III and developed instructions for the Operating Agent to draft the final report. The October workshop reviewed and amended a draft final report. It also developed and accepted in principle a proposal for Annex IV on Greenhouse Gases and National Energy Options.

In July, 1989, the ETSAP Executive Committee presented an overview report of carbon dioxide (CO_2) studies in four countries to the IPCC Energy and Industry Subgroup in Tokyo.

The final report on Annex III of ETSAP was adopted at a meeting of the Executive Committee in April, 1990. It will be published by Brookhaven National Laboratory in the near future.

A Canadian research contribution to ETSAP on the reduction of acid gas emissions in the Province of Quebec has been completed; it is Chapter 4 in the Final Report of Annex IV. This work was carried further under a separate contact to contribute to an evaluation of the federal program on Long-Range Transport of Air Pollutants (LRTAP).

7. Publications/Papers/Reports in 1989-90:

Brookhaven National Laboratory, (1990). *Estimating National Costs of Controlling Emissions from the Energy System*: final report of Annex III of the Energy Technology Systems Analysis Programme, report prepared for Environment Canada.

Berger, C., E. Lessard R. Loulou and J-P Waaub, (1989). *Exploring Acid Gas Emission Reductions in the Province of Quebec via MARKAL-Quebec,* report prepared for Environment Canada.

Loulou, R., (1989). *Additional Analysis of Acid Gas Emissions and Reductions in Quebec,* report prepared for Environment Canada.

International Energy Agency, (1989). *Energy System Options to Reduce CO_2 Emissions,* reprint as Appendix A in the final report of ETSAP Annex III.

8. Proposed PERD Resources: $34K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	34.00	0.00	0.00	0.00	0.00	34.00	0.00
EC	20.61	0.00	50.00	0.70	0.00	70.61	0.70
OTHERS:							
Germany	200.00	21.00	0.00	0.00	0.00	221.00	0.00
Italy	150.00	21.00	0.00	0.00	0.00	171.00	0.00
Japan	500.00	21.00	0.00	0.00	0.00	521.00	0.00
Nether.	200.00	21.00	0.00	0.00	0.00	221.00	0.00
Sweden	150.00	21.00	0.00	0.00	0.00	171.00	0.00
Switz.	50.00	21.00	0.00	0.00	0.00	71.00	0.00
UK	100.00	21.00	0.00	0.00	0.00	121.00	0.00
USA	0.00	21.00	0.00	0.00	0.00	21.00	0.00
CEC	0.00	21.00	0.00	0.00	0.00	21.00	0.00
TOTAL	1436.90	189.00	50.00	0.70	0.00	1643.61	0.70

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Brookhaven National Laboratory	U.S.A.	KA171-7-1855	**21.12**
GERAD, Group d'études	Quebec	KA171-9-8546	**42.49**
TOTAL CONTRACTS			**63.61**

1. Title: Carbon Cycle and Climate Modelling

2. Project #: 48113

3. **TASK** 4 - **RENEWABLE ENERGY & GENERIC ENVIRONMENT**
   PROGRAM 4.8 - GENERIC ENVIRONMENT

4. Project Management:
   a) Project Manager(s): H. Higychi
   b) Service: EC/AES
   c) Address: Downsview, Ontario
   d) Phone Number: (416) 734-4452

5. Project Objective(s):

   a) To develop a two-dimensional climate model.

   b) To incorporate inorganic marine carbon cycle into a two-dimensional diffusive-advective ocean model.

6. Project Accomplishment(s):

   a) A two-dimensional climate model, based on Peng et. al, 1987, Journal of Geophysical Research, has been developed. A significant improvement has been made to the radiation code.

   b) Inorganic carbon cycle has been incorporated into the University of McGill's two-dimensional ocean model.

7. Publications/Papers/Reports in 1989-90:

Chan, Y.-H., (1990). *Modelling the Terrestrial Biosphere in the Global Carbon Cycle – An Annotated Bibliography*, AES Report.

Lin, C., and K. Higuchi, (1989). *Internal mixing processes of the oceans and their effect on the global carbon cycle*, papaer presented at the Third International Conference on Analysis and Evaluation of Atmospheric C0, Data, Present and Past, Hinterzarton, 16-20 Oct., 1989, WMO Environmental Pollution Monitoring and Research Programme, No. 59, 210-214.

Lin, C., and K. Higuchi, (1990). *The Role of the Oceans in the Global Carbon Cycle*, poster presentation at Modelling the Physics, Biology and Chemistry of the Upper Ocean, and its Interaction with the Atmosphere, March 12-18, 1990, The Royal Society, London, England.

8. Proposed PERD Resources: $100K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	43.00	47.00	0.00	0.00	10.00	100.00	0.00
EC	0.00	0.00	20.00	0.40	0.00	20.00	0.40
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	43.00	47.00	20.00	0.40	10.00	120.00	0.40

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Dr. Charles Lin, McGill University	Quebec		25.00
Dr. Mary Ann Jenkins, York University	Ontario		13.00
Western Ecological Services Ltd.	B.C.		5.00
TOTAL CONTRACTS			**43.00**

TASK 5

ALTERNATIVE TRANSPORTATION FUELS

Energy R&D Program
PERD Task 5 Expenditure Summary

Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)															
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
51202	Demo. of Liquid Fuel Prod. from Sewage Sludge	310	0.0	67	199	90	0	0.0	356	0	20	0	62	1.1	82	0.0	0	1.1	438
57101	Pollution Abatement Technologies	179	1.0	125	0	0	54	1.0	179	0	0	0	5	0.1	5	0.5	105	1.6	289
57114	Environmental Implic. of Synfuel Processes	192	1.0	36	0	0	54	1.0	134	0	4	0	14	0.3	18	0.0	0	1.3	152
57115	Impacts of NLF in Motor Vehicles	35	0.0	0	35	0	0	0.0	35	0	15	0	75	1.1	90	0.0	0	1.1	125
57117	Heavy Duty Vehicle Testing Facility	0	0.0	0	70	0	0	0.0	70	0	100	100	119	2.2	319	0.0	0	2.2	389
57201	Hydrogeo. Aspects of Bitumen/Heavy Oil Recov.	100	0.0	3	95	0	0	0.0	98	0	0	0	20	0.3	20	0.0	0	0.3	118
57202	Treat. of Aqueous Effluents at Insitu Operations	479	2.0	162	159	50	108	2.0	479	0	125	0	135	3.0	260	0.0	141	5.0	880
57203	Treat. of Oil/Water/Sand Insitu Sludges	240	0.0	195	105	0	0	0.0	300	13	15	0	43	0.8	71	0.1	20	0.9	391
57204	Treat. Techn.: Heavy Oil Shipping Wastewater	14	0.0	4	10	0	0	0.0	14	0	0	0	3	0.1	3	0.0	0	0.1	17
57205	Aquatic Regulatory Criteria & Protocols	40	0.0	28	34	0	0	0.0	62	10	54	106	246	4.4	416	0.0	0	4.4	478
TASK5	Alternative Transportation Fuels	1,589	4.0	620	751	140	216	4.0	1,727	23	333	206	722	13.4	1,284	0.6	266	18.0	3,277

1. Title: Demonstration of Liquid Fuel Production from Sewage Sludge

2. Project #: 51202

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.1 - HYDROCARBONS ENHANCEMENT
SUBPROGRAM 5.1.2 - LIQUEFACTION OF COAL, BIOMASS AND SOLID WASTES

4. Project Management:
a) Project Manager(s): Herb W. Campbell
b) Service: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4717

5. Project Objective(s):

a) To continue operation of the laboratory reactor system to determine the fuel quality, compare equivalency to diesel, and evaluate cost of production.

b) To generate large quantities of oil using 1 ton per day oil-from-sludge pilot plant for the assessment of performance and environmental evaluation. This pilot plant was constructed in 1987 by Petro-Sun International (PSI) and is operated since then by the municipality of Hamilton.

c) To assist licensee, Enersludge Inc. (a Canadian company owned 50% by SNC and 50% by Campbell Environmental Ltd. of Perth, Australia), in commercializing the oil-from-sludge technology.

6. Project Accomplishment(s):

The project has demonstrated that sewage sludges can be thermally processed to liquid and solid fuels. Heating sewage sludge at approximatelly 400°C under inert conditions produced a synthetic oil and coal-like residue. This technology apprears to be very cost effective and if the oil can be marketed at $30/barrel, sludge processing costs are likely to be at least $60/tonne lower than any competitive incineration-based technology. Laboratory scale studies indicates that a diesel equivalent fuel can be produced.

Pattent applications have been filed in Canada, USA, Europe and Japan. Worldwide interest in the technology continues to grow, particularly in areas such as New York and New Jersey who are under tremendous pressure to identify alternative sludge management systems. Additional interest has been expressed by cities such as Houston, Edmonton and Hong Kong.

Specific accomplishments are the following.

a) Generated sufficient quantities of oil to begin marketing evaluation.
b) Initiated joint program with Still Otto of West Germany to evaluate oil as a diesel fuel.
c) Initiated joint program with EMR/CANMET and SNC of Montreal to develop additional end uses for oil.
d) Continued negotiations with municipality for demonstration site.

7. Publications/Papers/Reports in 1989-90:

Environemnt Canada, (1990). *Converting Sludge to Fuel - A Status Report* presented at the 19th National Conference on Municipal Sewage Treatment Plant Sludge Management, New Orleans, June 1989, and as a poster presentation at the IAWPRC Sludge Management Conference, Los Angeles, January, 1990.

8. Proposed PERD Resources: $310K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	66.80	199.00	0.00	0.00	90.00	355.80	0.00
EC	0.00	20.00	62.15	1.10	0.00	82.15	1.10
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	66.80	219.00	62.15	1.10	90.00	437.95	1.10

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Gary Smylski	Ontario	KE 405-9-6263	36.70
Angus Employment	Ontario	KE 405-9-6332	30.10
TOTAL CONTRACTS			66.80

1. Title: Pollution Abatement Technology Assessment Project

2. Project #: 57101

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.1 - ENVIRONMENT - NEW LIQUID FUELS

4. Project Management:
a) Project Manager(s): Rick Scroggins
b) Service: EC/C&P
c) Address: Hull, Quebec
d) Phone Number: (819) 997-1223

5. Project Objective(s):

a) Complete Phase IIA: improved organic analytical method validation study and Phase IIB: further validation of organic and toxicity testing analytical methods for gas plant waste sludge characterization method development project.

b) Initiate Phase III waste sludge treatment technology project.

c) Initiate Phase I of gas plant subsurface remediation technology demonstration project.

6. Project Accomplishment(s):

a) The organic analysis and the aquatic toxicity tests appeared more sensitive to the gas plant centrifugate samples than the terrestrial tests of the corresponding sludges. The toxicity test data demonstrate a degree of reproducibility comparable to the chemical analyses results.

b) Organized and participated in the the Conference on Prevention and Treatment of Subsurface Contamination by Hydrocarbons from the Upstream Petroleum Industry, May, 1989.

7. Publications/Papers/Reports in 1989-90:

Western Research, (in press). *Optimization of Organic Contaminant and Toxicity Testing Analytical Procedures for Estimating the Characteristic and Environmental Significance of Natural Gas Processing Plant Waste Sludges*, final report of Phase IIB study prepared for Environment Canada.

Environment Canada, (1989). *Prevention and Treatment of Groundwater and Soil Contamination in Petroleum Exploration and Production*, conference proceedings, May 9-11, 1989.

8. Proposed PERD Resources: $179K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	125.00	0.00	54.00	1.00	0.00	179.00	1.00
EC	0.00	0.00	5.40	0.10	0.00	5.40	0.10
OTHERS: CPA/ERAC[1]	0.00	102.50	2.70	0.50	0.00	105.20	0.50
TOTAL	125.00	102.50	62.10	1.60	0.00	289.60	1.60

[1] Canadian Petroleum Association and Environmental Research Advisory Council

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Western Research	Alberta		0.00
Alberta Research Council	Alberta		0.00
Bromley Engineering	Alberta		0.00
Piteau Engineering	Alberta		0.00
Envirotest Laboratories	Alberta		0.00
TOTAL CONTRACTS			0.00

1. Title: Environmental Impact of Polynuclear Aromatics (PNA's) from Synfuel Processing and Utilization

2. Project #: 57114

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.1 - ENVIRONMENT - NEW LIQUID FUELS

4. Project Management:
a) Project Manager(s): Herb W. Campbell
b) Service: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4717

5. Project Objective(s):

a) To characterize residues from EMR/CANMET co-processing/heavy oil and processes.

b) To support PERD Project 51202 - Demonstration of Liquid Fuel Production from Sewage Sludge by characterizing and combusting oils from sludges.

6. Project Accomplishment(s):

a) The composition of five oil samples generated from raw, digested and primary sludge and two diesel fuels were analysed and a thermal destruction study was done on all seven samples. The analysis of the chemical composition of oils and diesel fuels using on intergrated analytical system was fone using two specific approaches: direct method (without treatment of the sample), and chemical class separation method.

b) Upgrading of the analytical system continued.

c) Combustion characteristics of oil from sludge compared to existing and proposed diesel fuels.

7. Publications/Papers/Reports in 1989-90:

Dearborn Chemical Co. Ltd., (1990). *Study on the Environmental Assessment of Sludge Conversion*, final report prepared for Environment Canada.

8. Proposed PERD Resources: $192K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	36.00	0.00	54.00	1.00	0.00	90.00	1.00
EC	0.00	4.30	14.13	0.25	0.00	18.43	0.25
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	36.00	4.30	68.13	1.25	0.00	108.43	1.25

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Dearborn Environmental Consultant	Ontario	KE 405-8-6020	35.00
TOTAL CONTRACTS			0.00

1. Title: Environmental Impact of Alternative Fuels in Motor Vehicles

2. Project #: 57115

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.1 - ENVIRONMENT - NEW LIQUID FUELS

4. Project Management:
a) Project Manager(s): Chandra B. Prakash
b) Service: EC/C&P
c) Address: Hull, Quebec
d) Phone Number: (819) 997-1614

5. Project Objective(s):

a) Study and assess the environmental implications of alternative transportation fuels.

b) To coordinate limited testing on these fuels at Environment Canada's Vehicle Emissions Testing Laboratory (VETL).

c) To make available to government, and other users specialized information pertaining to the environmental impact of alternative fuels on the broad issues of climatic change, ground level ozone, acid rain, urban air quality and air toxics.

6. Project Accomplishment(s):

A computer database system was developed for the storage and retreival of scientific information and data on emissions of alternative fuels.

7. Publications/Papers/Reports in 1989-90:

Prakash, C.B., (1989). *Motor Vehicle Emissions from Gasoline Containing MTBE*, IP-97.

Prakash, C.B. and C. Wachmann, (1989). *Emissions Performance of Ethanol Containing Transportation Fuels*, proceedings of the 7th Canadian Bioenergy R&D Seminar, Page 517, April 24-26, 1989, Ottawa.

Prakash, C.B., (1989). *The Use of Gasohol as a Motor Vehicle Fuel*, Environment Canada internal report.

Prakash, C.B., (1989). *Global Warming - CO_2 Contribution of Biomass Ethanol*, Environment Canada internal report.

Prakash, C.B., (1990). *Alternative Transportation Fuels and their Emissions*, Environment Canada internal report.

8. Proposed PERD Resources: $35K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	35.00	0.00	0.00	0.00	35.00	0.00
EC	0.00	15.00	74.80	1.10	0.00	89.80	1.10
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	50.00	74.80	1.10	0.00	124.80	1.10

1. Title: Emissions Testing from Heavy Duty Vehicles

2. Project #: 57117

3. TASK 5 - **ALTERNATIVE TRANSPORTATION FUELS**
   PROGRAM 5.7 - ENVIRONMENT
   SUBPROGRAM 5.7.1 - ENVIRONMENT - NEW LIQUID FUELS

4. Project Management:
   a) Project Manager(s): Chandra B. Prakash
   b) Service: EC/C&P
   c) Address: Hull, Quebec
   d) Phone Number: (819) 997-1614

5. Project Objective(s):

   a) To study and assess the environmental implications of using alternative fuels in heavy-duty vehicles.

   b) To coordinate testing at Environment Canada's Vehicle Emissions Testing Laboratory (VETL).

   c) To provide specialized scientific and technical information on emission testing of heavy-duty vehicles using alternative fuels.

6. Project Accomplishment(s):

   The installation of heavy-duty chassis dynamometer at VETL was completed and emissions testing started in March 1990.

7. Proposed PERD Resources: $0K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	70.00	0.00	0.00	0.00	70.00	0.00
EC	0.00	100.00	118.80	2.20	100.00	318.80	2.20
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	170.00	118.80	2.20	100.00	388.80	2.20

1. Title: Impacts from In-Situ Oil Sands and Heavy Oil Disposal Practices

2. Project #: 57201

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.2 - ENVIRONMENT: UPSTREAM OIL SANDS AND HEAVY OILS

4. Project Management:
a) Project Manager(s): Gary Grove
b) Service: EC/C&P
c) Address: National Hydrology Research Centre
Saskatoon, Sask.
d) Phone Number: (306) 975-5741

5. Project Objective(s):

a) To identify suitable sites for the instalation of a demonstration monitoring facility in an existing disposal well (i.e. Swan Hills Special Waste Facility) or a nearby unused well. The field site will be used to measure the impacts resluting from heavy oil subsurface partices, and report on monitoring and predictive capability for evaluating impacts of oil sands and heavy oil subsurface disposal practices.

b) To develop and implement a project with industrial and other partners to collect new field data in the Cold Lake area.

6. Project Accomplishment(s):

Work was completed on the Stanley Associates Engineering Limited contract to identify potential monitoring sites in the Cold Lake area and the report was distributed to members of the technical committee for the project. The evaluation on deep well monitoring data indicated that the information for existing oil sands and heavy oil disposal wells are not suitable for modelling. However, using test data from the Swan Hills Special Waste Facility, the Alberta Research Council (ARC) model can provide reasonable predictions of the effects of wastewater injection. Sufficiant infromation must be available to make reliable estimates of the hydrogeologic parameters for a site or adequate monitoring data in order to calibrate the model prior to using it in a predictive mode.

7. Publications/Papers/Reports in 1989-90:

Stanley Associates Engineering Limited, (1989). *Monitoring and Predictive Capability for Evaluating Impacts from In-Situ Sand/Heavy Oil Subsurface Disposal Practices.* prepared for NHRI Contribution Number #90025, 31 pp, 5 app.

8. Proposed PERD Resources: $100K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	3.00	95.00	0.00	0.00	0.00	98.00	0.00
EC	0.00	0.00	20.00	0.33	0.00	20.00	0.33
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	3.00	95.00	20.00	0.33	0.00	118.00	0.33

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Stanley Associates Engineers Ltd.	Alberta		3.00
TOTAL CONTRACTS			3.00

1. Title: Treatment of Aqueous Effluents from In-Situ Bitumen and Heavy Oil Recovery Operations

2. Project #: 57202

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.2 - ENVIRONMENT: UPSTREAM OIL SANDS AND HEAVY OILS

4. Project Management:
a) Project Manager(s): Jim W. Schmidt
b) Service: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4541

5. Project Objective(s):

To develop and demonstrate cost-effective treatment technologies for the recycling of surface water discharge of wastewaters from in-situ bitumen/heavy oil recovery operations.

6. Project Accomplishment(s):

a) In-house electrodialysis membrane screening work was completed.

b) In-house bench-scale electrodialysis work for removal of total dissolved solids (TDS) from produced water was completed.

c) Part I of Phase II of joint industry-government field trials on micro-filtration, ultrafiltration and electrodialysis was completed. The ultrafiltration work was conducted under a joint study with Energy, Mines and Resources and Zenon Environmental. Draft report on Part 1 - Phase II in preparation.

d) Decision to go ahead with Part 2 - Phase II made by Environment Canada, Alberta Oil Sands Technology and Research Authority (AOSTRA) and industry.

e) Draft reports on performance evaluation of oil removal processes were prepared and sent to two oil companies. The work conducted to date has provided hard data to help the oil industry and the regulatory agencies (Energy Resources Conservation Board (ERCB) and Alberta Environment) improve the plan for the development of heavy oil in an environmentally desirable manner.

7. Publications/Papers/Reports in 1989-90:

(1989). *Lindbergh Area Produced Water Treatment Study-Phase One:* final report, Alberta Oil Sands Technology and Research Authority, Environment Canada, Amoco Canada Petroleum Company Ltd., Dome Petroleum Ltd., Murphy Oil Company Ltd., Pan Canadian Petroleum Ltd., Westmin Resources Ltd.

Kok, S., A. Zaidi, and R. Solomon, (1989). *Total Dissolved Solids Removal from Water Produced During the In-Situ Recovery of Heavy Oil and Bitumen,* Journal of Canadian Petroleum Technology, 28(1).

Simms, K., A. Zaidi and S. Kok, (1989). *Performance of Induced Gas Flotation Systems for Removal of Oil from Water Production during the In-Situ Recovery of Heavy Oil,* presented at the American Chemical Society Meeting, Division of Environmental Chemistry, Dallas Texas, April 9-14, 1989.

8. Proposed PERD Resources: $479K (2.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	162.00	159.00	108.00	2.00	50.00	479.00	2.00
EC	0.00	125.00	135.00	3.00	0.00	260.00	3.00
OTHERS: Industry[1]	0.00	141.00	0.00	0.00	0.00	141.00	0.00
TOTAL	162.00	425.00	243.00	5.00	50.00	880.00	5.00

[1] Industry includes:
Amoco Canada Petroleum Company Ltd.
Dome Petroleum Ltd.
Murphy Oil Company Ltd.
Pan Canadian Petroleum Ltd.
Westmin Resource Ltd.

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Wastart Ltd.	Ontario		0.00
Tyad Oilfield Services	Alberta		0.00
Separ Systems and Research	Alberta		0.00
Ken Unkerskov	Ontario		0.00
Zenon Environmental Inc.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Treatment and Disposal Practices for Sludge from Heavy Oil Recovery Operations

2. Project #: 57203

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.2 - ENVIRONMENT: UPSTREAM OIL SANDS AND HEAVY OILS

4. Project Management:

a) Project Manager(s):	Rick Scroggins	J. Harrison
b) Service:	EC/C&P	EC/C&P
c) Address:	Hull, Quebec	Regina, Sask
d) Phone Number:	(819) 997-1223	(306) 780-6445

5. Project Objective(s):

a) Continuation of two land treatment field demonstrations and Wastewater Technology Centre's project on fate and persistence of heavy oil waste toxics.

b) Completion of Phase I study which assessed technology options for treating problematic oil field wastes.

6. Project Accomplishment(s):

The land treatment R&D findings have had a substantial influence on industry's oily waste disposal practices and will be used in the revision of the Government of Alberta's guidelines on oily waste land treatment in the near future.

7. Publications/Papers/Reports in 1989-90:

Kanaskis Centre for Environmental Research, University of Calgary, (1988). *Disposal of Oil from Waste on Land Treatment: Effect on the Environment and Implication for Future Land Use,* report prepared for Environment Canada.

CH_2M Hill, (1989). *Evaluation of Technology for the Treatment of Waste Sludges and Solids Contaminated with Salinity, Metals and Hydrocarbons,* report prepared for Environment Canada.

Laidlaw Ltd., (1989). *Development of Processes for Oil Recovery from Waste Oil Sludges,* report prepared for Environment Canada Manuscript Series IP-104.

8. Proposed PERD Resources: $240K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	195.00	105.00	0.00	0.00	0.00	300.00	0.00
EC	12.50	15.30	43.12	0.77	0.00	70.92	0.77
OTHERS: CPA/ERAC[1]	0.00	14.20	5.60	0.10	0.00	19.80	0.10
TOTAL	207.50	134.50	48.72	0.87	0.00	390.72	0.87

[1] Canadian Petroleum Association/Environmental Research Advisory Council

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
University of Calgary	Alberta		0.00
CH_2M Hill	Alberta		0.00
K. Hoslter, WTC	Ontario		0.00
V.O. Biederbeck, Agriculture Canada	Sask.		0.00
TOTAL CONTRACTS			0.00

1. Title: Development and Demonstration of Treatment Technologies for the Wastewater Generated from Shipping of Heavy Oil as a Water Emulsion

2. Project #: 57204

3. TASK 5 - ALTERNATIVE TRANSPORTATION FUELS
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.2 - ENVIRONMENT: UPSTREAM OIL SANDS AND HEAVY OILS

4. Project Management:
a) Project Manager(s): Jim W. Schmidt
b) Service: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4541

5. Project Objective(s):

To develop and demonstrate technologies for the treatment of wastewater generated from the shipment of heavy oil as an emulsion containing 30-50% water.

6. Project Accomplishment(s):

Canadian Occidental Petroleum and British Petroleum (BP) negotiated with Environment Canada on a potential joint program on the charateristics and treatability of the wastewater from heavy oil as an emulsion transportation operation. Environment Canada has been approched by these oil companies to help in characterizing the wastewater and developing the treatment technologies for the management of the wastewater in an environmentally acceptable manner.

7. Proposed PERD Resources: $14K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	3.90	10.10	0.00	0.00	0.00	14.00	0.00
EC	0.00	0.00	3.40	0.05	0.00	3.40	0.05
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	3.90	10.10	3.40	0.05	0.00	17.40	0.05

1. Title: Aquatic Assessment Protocols for Oil Sands Operations

2. Project #: 57205

3. **TASK** 5 - **ALTERNATIVE TRANSPORTATION FUELS**
PROGRAM 5.7 - ENVIRONMENT
SUBPROGRAM 5.7.2 - ENVIRONMENT: UPSTREAM OIL SANDS AND HEAVY OILS

4. Project Management:
a) Project Manager(s): Ed D. Ongley
b) Service: EC/C&P
c) Address: National Water Research Institute
Burlington, Ontario
d) Phone Number: (416) 336-4913

5. Project Objective(s):

a) A preliminary survey of the Athabasca River below Fort McMurray was carried out to collect a limited number of water, sediment and fish samples for polycyclic aromatic hydrocarbon (PAH) analysis.

b) Ecotoxicological testing of water and sediments.

6. Project Accomplishment(s):

a) In August 1989, water, suspended sediment and bed sediment were collected from six sites above, near and below the tar sands plants. Ecotoxicological testing is nearly complete and preliminary chemical analysis has been done.

b) In August 1989, fish were collected from three sites on the Syncrude lease and two sites on the Athabasca River. Composite samples of bile, liver and muscle were analyzed for PAH's and metabolites. No compounds attributable to oil sands mining and upgrading operations were found in these samples.

c) In March 1990, water, suspended sediment and bed sediment for chemical and ecotoxicological analyses were collected from four sites above and below the oil sands plants.

d) Working level relations have been established with Alberta Environment and Syncrude Canada Ltd.

e) Some aspects of this project are being coordinated with the Wood Buffalo National Park monitoring program of Environment Canada's Western and Northern Region.

7. Proposed PERD Resources: **$40K**

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	28.00	34.00	0.00	0.00	0.00	62.00	0.00
EC	10.00	54.00	246.40	4.40	106.00	416.40	4.40
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	38.00	88.00	246.40	4.40	106.00	478.40	4.40

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
RL&L Environmental	Alberta	KW 405-9-1235	1.40
EnviroTest Laboratories	Alberta	KW 405-9-1627	36.70
TOTAL CONTRACTS			**38.10**

TASK 6

OIL, GAS AND ELECTRICITY

Energy R&D Program
PERD Task 6 Expenditure Summary

Proj. #	Title	1989-90 Proposed		1989-90 as spent ($K and PY's)															
				Panel on Energy R&D						Environment Canada						Other Funding Sources		Total	
		K$	PY	Contr. $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Contr $K	O&M $K	Capit $K	Sal&B $K	Sal&B PY	Total $K	Sal&B PY	Total $K	Sal&B PY	Total $K
61207	Climate Change & Permafrost	0	0.0	0	0	0	0	0.0	0	5	0	0	9	0.2	14	0.0	12	0.2	26
62120	Wave/Wind Hindcasting	220	0.5	113	63	20	24	0.5	220	0	17	0	53	0.9	70	0.0	59	1.4	349
62121	Combined Envt'l Extremes	40	0.0	23	17	0	0	0.0	40	0	6	0	7	0.1	13	0.0	13	0.1	66
62122	Eval. of Climatologies	50	0.0	33	17	0	0	0.0	50	0	0	0	7	0.1	7	0.0	0	0.1	57
62123	Wave Turbulence Interaction	34	0.0	0	79	0	0	0.0	79	0	9	23	26	0.4	58	0.0	0	0.4	137
62124	Shoaling Waves	30	0.0	0	30	0	0	0.0	30	0	6	15	33	0.6	54	0.0	0	0.6	84
62137	West Coast Waves	100	0.0	93	7	0	0	0.0	100	0	14	0	21	0.3	35	0.0	0	0.3	135
62322	Sea Ice Distribution	116	1.0	30	15	24	47	1.0	116	0	50	0	10	0.4	60	0.0	0	1.4	176
62323	Marine Icing	40	0.0	36	4	0	0	0.0	40	0	9	0	17	0.3	26	0.0	10	0.3	76
62338	Ice Digitization Technology	40	0.0	15	5	20	0	0.0	40	0	0	12	9	0.1	21	0.0	0	0.1	61
67116	Satellite Radar Studies	400	0.0	0	0	400	0	0.0	400	0	0	386	26	0.4	412	0.0	0	0.4	812
67118	Satellite Communications	99	0.0	50	18	0	0	0.0	68	0	26	1,091	11	0.2	1,128	0.0	0	0.2	1,196
67135	Atlantic Storms	154	1.0	106	48	0	48	1.0	202	0	45	50	75	1.3	170	0.0	0	2.3	372
67145	Oil Mixing by Waves	60	0.0	50	0	0	0	0.0	50	0	0	0	26	0.6	26	0.0	0	0.6	76
67150	CASP II	80	0.0	0	80	0	0	0.0	80	0	0	100	17	0.3	117	0.0	0	0.3	197
67154	Marine Wind Forecasting	140	0.0	127	1	0	0	0.0	128	0	0	0	55	0.9	55	0.0	0	0.9	183
67155	Ocean Wave Modelling	174	1.5	97	2	0	80	1.5	179	0	30	0	22	0.6	52	0.0	0	2.1	231
67156	ERICA	150	0.0	98	52	0	0	0.0	150	0	45	50	75	1.3	170	0.0	1,000	1.3	1,320
67158	Operational Ice Modelling	100	0.0	0	100	0	0	0.0	100	0	0	0	7	0.1	7	0.0	0	0.1	107
67164	Climate Change East Coast	30	0.0	30	0	0	0	0.0	30	1	3	0	11	0.2	15	0.0	0	0.2	45
67237	Hydrocarbon Monitoring	60	0.0	55	3	0	0	0.0	58	55	0	0	12	0.2	67	0.2	115	0.4	240
67239	Organic Pollutants-Flare Stacks	100	0.0	0	1	0	46	1.0	47	5	8	0	20	0.3	33	0.0	0	1.3	80
67245	Prod. Water Alternatives	56	1.0	12	66	0	0	0.0	78	0	53	0	13	0.2	66	0.0	0	0.2	144
67246	Biodegr. of Base Oils	25	0.0	25	5	0	0	0.0	30	0	0	0	12	0.2	12	0.0	0	0.2	42
67258	R&D Coordination/ Workshops	30	0.0	0	30	0	0	0.0	30	0	0	0	0	0.0	0	0.0	0	0.0	30
67267	Pollution Perspectives	50	0.0	40	0	10	0	0.0	50	0	0	0	0	0.0	0	0.0	0	0.0	50
TASK6	Oil, Gas and Electricity	2,378	5.0	1,033	643	474	245	5.0	2,395	66	321	1,727	574	10.2	2,688	0.2	1,209	15.4	5,331

1. Title: Climate Change and Permafrost

2. Project #: 61207

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.1 - GEOSCIENTIFIC R&D
SUBPROGRAM 6.1.2 - PERMAFROST & GAS HYDRATES

4. Project Management:
a) Project Manager(s): Mel O. Berry
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4343

5. Project Objective(s):

a) To provide a state-of-the-art summary regarding regional climate change, specifically considering the MacKenzie Valley region.

b) To develop figures showing regional historical temperature changes in the northern hemisphere during periods of warming and/or cooling.

c) To submit notes based on two previous PERD contracts (from FY 1987/88 and 1988/89) to appropriate journals for refereed publication.

6. Project Accomplishment(s):

The summary of the finding is that climate models predict significant changes in the world's climate over the next 50 to 100 years due to increasing atmospheric greenhouse gases. To what extent these predictions can be believed has been the subject of considerable scientific debate. It seems reasonable to conclude that significant changes in climate, perhaps rivalling the last transition into an interglacial period, are likely. The confidence one can have in climate predictions decreases with scale, such that below a continental scale one cannot consider climate predictions from numerical models to be a reasonable guide to future trends.

7. Publications, Papers, Report in 1989-90:

Etkin, D., (1991), *Enhanced Greenhouse Warming and the Mackenzie Valley NWT: Regional Response and Believability*, Canadian Climate Centre Report Series.

8. Proposed PERD Resources: $0K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EC	5.00	0.00	8.50	0.15	0.00	13.50	0.15
OTHERS: EMR/GS[1]	12.00	0.00	0.00	0.00	0.00	12.00	0.00
TOTAL	17.00	0.00	8.50	0.15	0.00	25.50	0.15

[1] Energy, Mines and Resources/Geological Survey

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Wx Research House Inc.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Wind and Wave Hindcasting

2. Project #: 62120

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management:
a) Project Manager(s): Val R. Swail
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4347

5. Project Objective(s):

a) To develop new methodologies for the specification of historical marine wind fields.

b) To produce extreme wind/wave hindcasts for the Grand Banks and Scotian Shelf areas, wind hindcast for the Beaufort Sea.

6. Project Accomplishment(s):

a) Completed extremes wind and wave hindcast report for Grand Banks/Scotian Shelf/Georges Bank; wind hindcast for Beaufort Sea.

b) Presented PERD-funded research at international conferences and workshops.

7. Publications/Papers/Reports in 1989-90:

MacLaren Plansearch Ltd. and Oceanweather, Inc., (1990). *Wind/Wave Hindcast Extremes for the East Coast of Canada: Volume I*, prepared for Atmospheric Environment Service, Downsview, Ontario.

MacLaren Plansearch Ltd., and Oceaweather Inc., (1990). *Wind/Wave Hindcast Extremes for the East Coast of Canada: Volume II - Georges Bank Tropical Storm Hindcast*, prepared for Atmospheric Environment Service, Downsview, Ontario.

8. Proposed PERD Resources: $220K (0.5 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	113.00	63.00	24.00	0.50	20.00	220.00	0.50
EC	0.00	17.00	53.40	0.90	0.00	70.40	0.90
OTHERS: COGLA/DND[1]	0.00	58.70	0.00	0.00	0.00	58.70	0.00
TOTAL	113.00	138.70	77.40	1.40	20.00	349.10	1.40

[1] Canada Oil and Gas Lands Administration and Department of National Defence

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
MacLaren Plansearch Ltd. Oceanweather Inc.	N.S. U.S.A.	KM169-7-6678	0.00
TOTAL CONTRACTS			0.00

1. Title: Combined Environmental Extremes

2. Project #: 62121

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management
a) Project Manager(s): Val R. Small
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4347

5. Project Objective(s):

Loads on offshore structures caused by extreme environmental conditions, such as wave, winds, currents, ice and icing, are generally considered in combination by simply adding the individual load values. This usually leads to over-design of offshore structures.

The objective is to develop and implement methods to estimate the occurrence of combined extreme events in order to provide the information on combinations of environmental parameter values required for input into loading models.

6. Project Accomplishment(s):

a) Implemented statistical software for time series analysis in AES MAST climate analysis systems.

b) Developed preliminary algorithms for probability of lead combinations due to environmental factors.

7. Publications/Papers/Reports in 89-90:

Det Norske Veritas (Canada) Ltd., (1990). *Development of Algorithms for Combined Environmental Extremes*, report prepared for Atmospheric Environment Service, 114 p.

8. Proposed PERD Resources: $40K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	22.80	17.20	0.00	0.00	0.00	40.00	0.00
EC	0.00	5.50	7.15	0.11	0.00	12.65	0.11
OTHERS: DNV[1]	0.00	13.00	0.00	0.00	0.00	13.00	0.00
TOTAL	22.80	35.70	7.15	0.11	0.00	65.65	0.11

[1] Det Norske Veritas Ltd.

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Det Norske Veritas Ltd.	Alberta	02SE-KM169-6774	0.00
W.F. Baird and Associates	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Evaluation of Climatologies

2. Project #: 62122

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management:
a) Project Manager(s): Val R. Swail
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4347

5. Project Objective(s):

To evaluate the reliability of published climatologies for offshore drilling areas in Canadian waters.

6. Project Accomplishment(s):

Completed component reports on engineering requirements for climatological data and evaluation of climatological data bases and evaluation of climatological data bases and statistical analysis techniques.

7. Proposed PERD Resources: $50K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	33.20	16.80	0.00	0.00	0.00	50.00	0.00
EC	0.00	0.00	7.15	0.11	0.00	7.15	0.11
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	33.20	16.80	7.15	0.11	0.00	57.15	0.11

6. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Seaconsult Marine Research Ltd.	B.C.		0.00
TOTAL CONTRACTS			0.00

1. Title: Wave Turbulence Interaction

2. Project #: 62123

3. **TASK** 6 **- OIL, GAS & ELECTRICITY**
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management:
a) Project Manager(s): Marc A. Donelan
b) Service: EC/C&P
c) Address: National Water Research Institute
Burlington, Ontario
d) Phone Number: (416) 336-4879

5. Project Objective(s):

a) To examine the spectral distribution of dissipation in a white capping sea.
b) To measure the velocity field beneath breaking waves. To explore the statistical properties of the vertical and horizontal velocity components in the context of expected forces on marine structures for design purposes. To devise improvements in the specification of velocities for design purposes.
c) To determine the vertical distribution of turbulent energy due to wave breaking and wind stress, and to explore the effects of wave-turbulence interaction on wave dissipation and on mixing in the near surface layer.

6. Project Accomplishment(s):

Considerable progress has been made in analyzing the data both with regard to comparison of orbital velocities with theory and assessing the extent of wave turbulence interaction. The analysis continues. The production runs on directional spectra are in progress and three papers are in preparation. The collected papers and final report are to be delivered on March 31, 1991. A paper on non-linear group propagation has been accepted for publication in the proceedings of the 11th Annual Canadian Applied Mathematics Conference.

7. Publications/Papers/Reports in 89-90:

W.M. Drennan, J.D. Fenton and M.A. Donelan, (1989). *Numerical Simulation of Non-linear Wave Groups.*

M.A. Donelan and F. Anctil, (in press). *A simple Method for Calculating the Velocity Field Beneath Irregular Waves.*

M.A. Donelan, N. Madsen, K.K. Kahma and I.K. Tsanis (1990). *Apparatus for Atmospheric Boundary Layer Measurements Over Waves.*

8. Proposed PERD Resources: $34K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	79.00	0.00	0.00	0.00	79.00	0.00
EC	0.00	9.00	26.40	0.44	23.00	58.40	0.44
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	88.00	26.40	0.44	23.00	137.40	0.44

1. Title: **Statistics of Shoaling Waves for Engineering Applications**

2. Project #: 62124

3. **TASK** 6 - **OIL, GAS & ELECTRICITY**
   PROGRAM 6.2 - MARINE ENGINEERING
   SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management:
   a) Project Manager(s): Marc A. Donelan
   b) Service: EC/C&P
   c) Address: National Water Research Institute
      Burlington, Ontario
   d) Phone Number: (416) 336-4879

5. Project Objective(s):

   a) To devise a theoretical procedure to obtain the joint distribution of wave heights and periods in shoaling water.

   b) To test the theoretical procedure using results from laboratory and field experiments.

6. Project Accomplishment(s):

   The field data from the three towers in Lake Ontario and laboratory facility have been analyzed. The laboratory tests with the gentlest slope (1:40) beach have been completed for the study of the joint distribution of heights and periods. Experiments are now underway to explore the velocity and energy dissipation field in shoaling waves using a three-dimensional acoustic current-meter.

7. Publications/Papers/Reports in 89-90:

   Doering, J.C. and Bishop, C.T., (1990). *Wave Height Prediction Using TMA;* presented at Canadian Coastal Conference.

8. Proposed PERD Resources: $30K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	30.00	0.00	0.00	0.00	30.00	0.00
EC	0.00	6.00	33.00	0.55	15.00	54.00	0.55
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	36.00	33.00	0.55	15.00	84.00	0.55

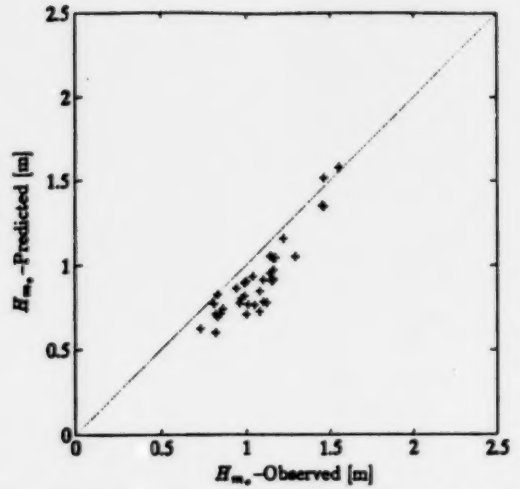


Figure 1: Observed charateristic wave height H_{m_o} for the field data versus that predicted using TMA method.

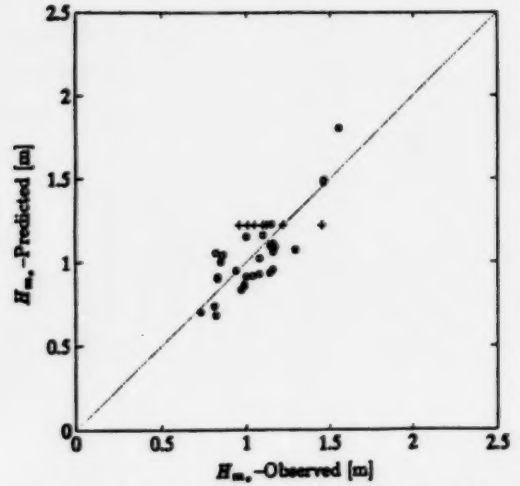


Figure 2: Observed charateristics wave height H_{m_o} for the field data versus that predicted using linear theory. Markers are as follows: o-nondepth-limited linear prediction, +-depth-limited linear

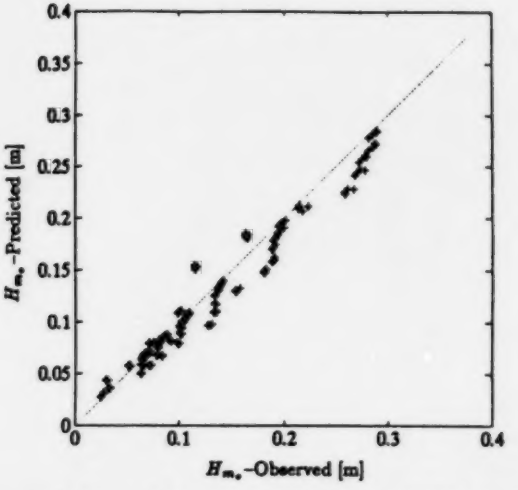


Figure 3: Observed charateristic wave height H_{m_o} for the laboratory data versus that predicted using TMA method.

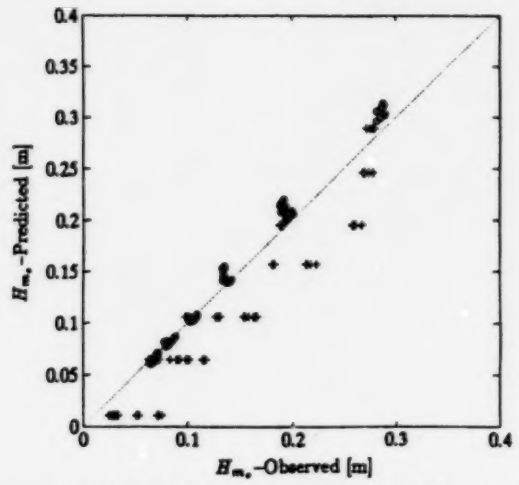


Figure 4: Observed chatacteristic wave height H_{m_o} for laboratory data versus that predicted using linear theory. Symbols as in figure 2.

1. Title: West Coast Waves Project

2. Project #: 62137

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.1 - DESIGN CRITERIA

4. Project Management:
a) Project Manager(s): Val R. Swail
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4347

5. Project Objective(s):

To produce extreme wind and wave hindcasts model for the west coast of Canada.

6. Project Accomplishment(s):

a) Set up wind and wave model for west coast of Canada by using the field wind and wave data. These historical wind and wave field data is necessary in order to calibrate the model.
b) The 50 most severe wave-producing storms have been identified and selected to study the extreme climatologies (storms). The region selected is the Queen Charlotte Sound and Dixon Entrance.

7. Proposed PERD Resources: $100K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	92.70	7.30	0.00	0.00	0.00	100.00	0.00
EC	0.00	13.60	21.45	0.33	0.00	35.05	0.33
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	92.70	20.90	21.45	0.33	0.00	135.05	0.33

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
MacLaren Plansearch Ltd.	N.S.		0.00
TOTAL CONTRACTS			0.00

1. Title: Sea Ice Distribution

2. Project #: 62322

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.3 - ICE AND ICE-STRUCTURE INTERACTION

4. Project Management:
a) Project Manager(s): Tom Agnew
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4385

5. Project Objective(s):

To develop a sea ice information system for Canadian waters in support of offshore arctic engineering design needs and support government regulatory agencies.

6. Project Accomplishment(s):

a) CRISP evaluation by Norland Science Ltd. as an outside user of the system.

b) Side-scanning multi-channel micro-wave radiometer (SMMR) and side-scanning micro-wave imager (SSMI) satellite microwave data incorporated into Canadian Climate Centre ice archive systems.

7. Publications/Papers/Reports in 1989-90:

Norland Sciences and Engineering Ltd, (1990). *CRISP - An evaluation of External User Requirements*, Canadian Climate Centre Report unpublished.

Agnew, T., (1990). *Arctic Sea-ice Cover and Sea-ice cover Anomalies over Eastern Canada*, 1990, Canadian Climate Change Report #90.

8. Proposed PERD Resources: $116K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	30.00	15.00	47.00	1.00	24.00	116.00	1.00
EC	0.00	50.00	10.00	0.40	0.00	60.00	0.40
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	30.00	65.00	57.00	1.40	24.00	176.00	1.40

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Dave Phillips	Ontario		0.00
Tricia Miles	Ontario		0.00
Det Norske Veritas	Alberta		0.00
Dr. Irene Rubinstein	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Marine Icing

2. Project: 62323

3. **TASK** **6 - OIL, GAS & ELECTRICITY**
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.3 - ICE AND ICE-STRUCTURE INTERACTION

4. Project Management:
a) Project Manager: Ron D. Brown
b) Service: EC/AES
c) Address: Ottawa, Ontario
d) Phone Number: (613) 996-4488

5. Project Objective(s):

a) To develop new methodologies for estimation of ice accretion loads on drilling platforms and supply vessels operating in offshore locations.

b) Carry out pulsed-spray icing experiments in a wind tunnel to gain a greater understanding of time-dependent effects in the accretion of saline water.

c) Develop a theoretical model for wave-generated spray impact on cylindrical structures.

d) To select a suitable platform in order to obtain field measurements of the spray flux impinging on vertical columns for verification and enhancement of the theoretical spray model.

e) Develop and test icing sensor based on ultra-sound technology.

6. Project Accomplishment(s):

a) Field program for measurement of spray parameters initiated late March, 1990.

b) Pulsed spray wind tunnel icing tests completed.

c) Theoretical spray model design completed.

d) Presented overview of PERD icing project at 1989 CMOS Congress, Rimouski, Quebec.

7. Publications/Papers/Reports in 89-90:

Brown, R.D. and I. Horjen, (1989). *Evaluation of State-of-the-Art Drilling Platform Icing Models*, Atmospheric Environment Service, Canadian Climate Centre Report 89-10, 80 p.

8. Proposed PERD Resources: $40K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	36.40	3.60	0.00	0.00	0.00	40.00	0.00
EC	0.00	8.60	16.83	0.33	0.00	25.43	0.33
OTHERS: NRC/IMD[1]	0.00	10.00	0.00	0.00	0.00	10.00	0.00
TOTAL	36.40	22.20	16.83	0.33	0.00	75.43	0.33

[1] National Research Council/Institute for Marine Dynamics

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Compusult Ltd.	Nfld		0.00
TOTAL CONTRACTS			0.00

1. Title: Ice Digitization Technology Development

2. Project #: 62338

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.2 - MARINE ENGINEERING
SUBPROGRAM 6.2.3 - ICE AND ICE-STRUCTURE INTERACTION

4. Project Management:

a) Project Manager(s):	Dave Mudry	Mel Berry
b) Service:	EC/AES	EC/AES
c) Address:	Ottawa, Ontario	Downsview, Ontario
d) Phone Number:	(613) 996-4214	(416) 739-4370

5. Project Objective(s):

a) Identify available technology for ice digitization.
b) Develop of a prototype system.

6. Project Accomplishment(s):

a) Technology survey done and report delivered by Magi Data.
b) Prototype system purchased and assembled.

7. Proposed PERD Resources: $40K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	15.00	5.00	0.00	0.00	20.00	40.00	0.00
EC	0.00	0.00	8.80	0.11	12.00	20.80	0.11
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	15.00	5.00	8.80	0.11	32.00	60.80	0.11

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Magi Data	Ontario	660ER-8-0003/85-ER	5.00
University of Waterloo (EOL)	Ontario	048SS.KM149-9-CO36	10.00
TOTAL CONTRACTS			15.00

1. Title: Satellite Radar Studies

2. Project #: 67116

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): John C. Falkingham
b) Service: EC/AES
c) Address: Ice Centre
Ottawa, Ontario
d) Phone Number: (613) 996-4552

5. Project Objective(s):

Complete the operational tests for the Ice Data Analysis and Integration System (IDIAS) to ensure it has the capability to integrate and analyze airborne radar and meteorological satellite imagery.

6. Project Accomplishment(s):

All acceptance testing to accept the IDIAS from the contractor was completed April 26, 1989 and the system was put into operational demonstration. By September 1989, the system was able to receive, display and integrate Synthetic Aperture Radar (SAR) data and Side-Looking Airborne Radar (SLAR) data received in real-time from the ice reconnaissance aircraft. By March 1990, IDIAS was also receiving meteorological satellite data via the AES meteorological satellite information system (METSIS).

Additionally, a study was initiated to analyze, in detail, the ERS-1 orbits in order to estimate the amount of aircraft flight time that might be saved by using ERS-1 data as a replacement.

7. Publications/Papers/Reports in 1989-90:

Froess, Travis, J.B., (1990). *ERS-1 Satellite Coverage*, Ice Centre Environment Canada, Internal Report.

Falkingham, John C. et al., (1989). *The Ice Data Integration and Analysis System at the Ice Centre Environment Canada*, proceedings of the North American Sea Ice Workshop, June 1989, University of Massachussets, Amherts, MA.

Klein, T., (1989). *The Validation of Orbit Prediction Software - NDRS and HRPT;* Ice Centre Environment Canada, internal report.

8. Proposed PERD Resources: $400K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	0.00	0.00	0.00	400.00	400.00	0.00
EC	0.00	0.00	25.52	0.44	386.20	411.72	0.44
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.00	25.52	0.44	786.20	811.72	0.44

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
MacDonald, Dettwiler & Associates	B.C.		0.00
TOTAL CONTRACTS			0.00

1. Title: Satellite Communications

2. Project #: 67118

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): Don Champ
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4931

5. Project Objective(s):

Complete design, build and commission the Ice Reconnaissance Detection Network (IRDNET) eight remote relay stations: Tuktoyaktuk, Cambridge Bay, Resolute Bay, Clyde River, Iqaluit, all in the N.W.T., Hopedale and Gander, Newfoundland and Charlottetown, P.E.I.. There are also satellite receiving stations at the Canadian Coast Guard Ice Operations offices at Iqaluit, Dartmouth, N.S., St. John's, Newfoundland, and, of course, the main receiver at the Environment Canada's Ice Centre in Ottawa.

6. Project Accomplishment(s):

a) IRDNET stations commissioned and design completed in March 1990.

b) In view of the quantity of data to be sent, it is reduced in resolution and encoded on board the aircraft to compress it by a factor of 32; thus for each hour of flight, the data can be transmitted in about 2 minutes. The data is transmitted to the ground at 2.4 GHz (giga-hertz) and satellite operates at 6 GHz and 4 GHz using the ANIK D2 satellite.

c) Environment Canada's Ice Centre checks and stores the data on disk until it can be fed to the Ice Data Integration and Analysis System for operational use.

7. Publications/Papers/Reports in 1989-90:

Environment Canada. *IRDNET Phase 1 Systems Manual.*

Environment Canada. *IRDNET Phase 2 Critical Design Review Manual.*

8. Proposed PERD Resources: $99K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	50.20	18.00	0.00	0.00	0.00	68.20	0.00
EC	0.00	25.60	10.56	0.22	1090.70	1,126.86	0.22
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	50.20	43.60	10.56	0.22	1,090.70	1,195.06	0.22

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Telesat Canada	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Canadian Atlantic Storms Program (CASP)

2. Project #: 67135

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): Jim W.S. Young
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4995

5. Project Objective(s):

a) To complete the analysis of CASP information.

b) To provide data to researchers using CASP data.

6. Project Accomplishment(s):

a) A number of scientific analyses were completed. This includes the nature of storms along the Nova Scotia coastline, the variation of precipitation within the storms, the explanation for some bands within the storms, and the documentation of a number of frontal passages over Nova Scotia and Sable Island.

b) A number of data requests were filled. Requests for data were made from several branches of AES, Bedford Institute of Oceanography, McGill University, York University, and the University of Toronto.

7. Publications/Papers/Reports in 1989-90:

Journal Articles: A total of 7 articles were published or submitted during 1989-90 by the Cloud Physics Research Division. Three CASP articles appeared in the special Monthly Weather Review issue of the Monthly Weather Review. Some of these articles are:

Donaldson, N.R. and R.E. Stewart, (1990). *Precipitation-Induced Fog*, Atmos. Res. (Submitted).

Raga, G.B., R.E. Stewart and N.R. Donaldson, (1990). *Microphysical Characteristics through the Melting Region of a Mid-Latitude Winter Storm*, J. Atmos. Sci. (Submitted).

Stewart, R.E., (1990): *Canadian Atlantic Storms Program: Progress and Plans of the Meteorological Component*, Bull. Amer. Meteor. Soc. (Submitted).

Stewart, R.E., C.A. Lin and S.R. Macpherson, (1990). *The Structure of a Winter Storm Producing Heavy Precipitation over Nova Scotia*, Mon. Wea. Rev., 118, 411-426.

Stewart, R.E., R.W. Crawford, N.R. Donaldson, T.B. Low and B.E. Sheppard, (1990). *Precipitation and Environmental Conditions during Accretion in Canadian East Coast Winter Storms*, J. Appl. Meteor.

Stewart, R.E., R.W. Crawford and N.R. Donaldson, (1990): *Precipitation Characteristics within Several Canadian East Coast Winter Storms*, Atmos. Res., 25, pp. 293-316.

Stewart, R.E., (1990). *On the Temperatures Near and the Motions of Low Pressure Centres in Winter Storms*, Atmos. Res. (in press).

(ii) Conference Articles: There were 4 conference articles presented or written during 1989-90 by the Cloud Physics Research Division. These are:

Raga, G.R., R.E. Stewart and N.R. Donaldson, (1990). *The Precipitation Transition Region in a Winter Storm*, AMS Cloud Physics Conference, San Francisco.

Raga, G.R., N.R. Donaldson and R.E. Stewart, (1990). *The Structure of the Precipitation Type Transition Region in a Winter Storm*, AMS Conf. Mesoscale Processes, Boulder, Colorado.

Stewart, R.E., (1989). *Heavy Precipitation along Coastlines in Canadian Winter Storms*, IAMAP Congress, Reading, England.

MacPherson, J.I. and G.A. Isaac, (1989). *Adverse Weather Operations during the Canadian Atlantic Storms Program*, 74th Symposium on Flight in Adverse Environmental Conditions, AGARD of NATO, Gol, Norway, 12/1-12/3.

8. Proposed PERD Resources: $154K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	106.00	48.00	48.00	1.00	0.00	202.00	1.00
EC	0.00	45.00	75.00	1.30	50.00	170.00	1.30
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	106.00	93.00	123.00	2.30	50.00	372.00	2.30

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Prof. C. Lin, McGill University	Quebec	KM175-7-6794	12.62
Prof. P. Taylor, York University	Ontario	KM175-9-7522	24.20
KelResearch Corp.	Ontario	KM175-9-7434	31.30
Dr. J. Salmon	Ontario	KM175-9-7523	20.00
Dr. N. Donaldson	Ontario	KM175-9-7503	17.60
TOTAL CONTRACTS			105.68

1. Title: Oil Mixing by Wind Waves

2. Project #: 67145

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:

a) Project Manager(s):	J.W.S. Young	Hans Martin
b) Service:	EC/AES	EC/AES
c) Address:	Downsview, Ontario	Downsview, Ontario
d) Phone Number:	(416) 739-4995	(416) 739-4471

5. Project Objective(s):

a) To develop a model for application to oil spill mixing by wind driven waves.

b) To expand our understanding of the mechanisms controlling oil dispersion.

c) To provide emergency response teams with a tool to evaluate the dispersion aspects of a spill in real-time.

6. Project Accomplishment(s):

a) A technique has been developed to estimate the mixing potential of a breaking wave field from either simple airborne photography or more sophisticated optical or microwave backscatter systems, as outlined in the references provided, based on both processed images and a model of the ocean surface.

b) The mixing potential can now be expressed as the weighted sum of the singularity strengths of fractal sub-sets (whitecaps) relative to the critical singularity strength at the entraining/dissipating cross-over. The associated energy cascade from the atmosphere to the sea surface has identified two imbedded fractal processes. Dispersion amongst fractal processes are an intensive area of investigation in many areas of physics and geophysics today, and so the above results offer much promise to our application, and ocean wave dynamics.

c) Estimation of the multi-fractals is a simple process and is capable of remote in-situ automated computation onboard an aircraft. It avoids making initial wind measurements and then deriving mixing potential by instead observing it directly, based on the dynamics and statistical geometry of breaking waves.

7. Publications/Papers/Reports in 1989-90:

Bernier, L., (1989). *Air Entrainment in Breaking Waves*, contractor's report.

B.R. Kerman, K. Szeto, R. Bloxam and S. Lovejoy, (1990). *Fractal Properties of Whitecaps*, submitted to Atmosphere-Ocean.

B.R. Kerman and Lucie Bernier, (1990). *Breaking Waves are Fractal Singularities*, submitted to J. Gephys. Res.

B.R. Kerman, (1990). *A Cantor Model of the Sea Surface*, submitted to J. Gephys. Res.

B.R. Kerman, (1990). *A Multifractal Equivalent of the Beaufort Scale of Sea State*, submitted to Nature.

8. Proposed PERD Resources: $60K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	50.00	0.00	0.00	0.00	0.00	50.00	0.00
EC	0.00	0.00	26.40	0.55	0.00	26.40	0.55
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	50.00	0.00	26.40	0.55	0.00	76.40	0.55

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
University of Ottawa,Co-op Student	Ontario		20.00
Concord Scientific	Ontario		10.00
Mandel Scientific Co.	Ontario		20.00
TOTAL CONTRACTS			50.00

1. Title: Canadian Atlantic Storms Program II (CASP II)

2. Project #: 67150

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): Jim W.S. Young
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4995

5. Project Objective(s):

The overall objective of CASP II is to focus on the meso-scale structure of storms in the Avalon Peninsula-Hibernia area. A particular emphasis will be placed on the severe frontal features wich pass through the area and on the couplings between storms, the coastlines, the ice fields, and the ocean. During 1989-90 the objective was to acquire dropsonde instrumentation and supplies, and to develop a preliminary experimental design.

6. Publications/Papers/Reports in 1989-90:

A preliminary experimental design document suggest that a few enhanced synoptic observation be made at the synoptic scales, that the main project area will be only a few hundread kilometers accross, and that special observations will be made from 2 rawinsonde sites to describe the tropospheric structure within the region of interest.

7. Proposed PERD Resources: $80K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	80.00	0.00	0.00	0.00	80.00	0.00
EC	0.00	0.00	16.50	0.33	99.60	116.10	0.33
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	80.00	16.50	0.33	99.60	196.10	0.33

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
National Centre for Atmospheric Research	U.S.A.	KM175-9-7708	99.60
TOTAL CONTRACTS			99.60

1. Title: Marine Wind Forecasting

2. Project #: 67154

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): Alan Bealby
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4908

5. Project Objective(s):

a) To develop a new and improved set of marine wind forecast equations using new data acquired and processed in 1987/88.
b) To validate and refine the standardized verification procedures using the new equations. Compare verification of statistical wind forecasts and the forecasts from dynamic models to determine best wind input for wave models. Verification methods are to be designed to clearly demonstrate performance of techniques for extreme events.

6. Project Accomplishment(s):

a) A new set of wind marine equations was developed to adapt the spectral model for Canadian application.
b) The spectral models was tested for unique problems of wave forecasting in Canadian waters (e.g. waves in presence of sea ice).

7. Proposed PERD Resources: $140K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	127.00	1.10	0.00	0.00	0.00	128.10	0.00
EC	0.00	0.00	55.00	0.88	0.00	55.00	0.88
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	127.00	1.10	55.00	0.88	0.00	183.10	0.88

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Acres International Ltd.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Ocean Wave Modelling

2. Project #: 67155

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): Alan Bealby
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4908

5. Project Objective(s):

The project is designed to adapt and test a newly acquired spectral wave model to the Pacific basin, this research spectral model has been shown to produce superior wave forecasts than present operational ocean wave forecasting model (based on the Bretschneider nomogram) used in Canada.

6. Project Accomplishment(s):

a) The spectral wave model is now being implemented for the Atlantic and Pacific at CMC. Final integration into CMC operational runs is now taking place. The spectral wave models for the Atlantic and Pacific coasts have been running in parallel since December 1989. Visual inspection and some limited verification has occurred. Some experimentation has been done to get the best wind data from the operational data sets.

b) Third generation source term code for the model was received and is now being evaluated for efficiency and effectiveness for research and operational uses.

7. Publications/Papers/Reports in 1989-90:

Khandekar, M.L., (1989). *Operational Analysis and Prediction of Ocean Wind Waves*, Coastal and Estuarine Studies. Springer-Verlag, 214 p.

8. Proposed PERD Resources: $174K (1.5 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	97.20	1.40	80.00	1.50	0.00	178.60	1.50
EC	0.00	30.00	22.00	0.55	0.00	52.00	0.55
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	97.20	31.40	102.00	2.05	0.00	230.60	2.05

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Oceanweather Inc. Atmospheric Dynamics Prism Data Services	U.S.A. B.C. Ontario		
TOTAL CONTRACTS			

1. Title: Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA)

2. Project #: 67156

3.

TASK	**6**	**- OIL, GAS & ELECTRICITY**
PROGRAM	6.7	- ENVIRONMENT
SUBPROGRAM	6.7.1	- ENVIRONMENTAL FORECASTING

4. Project Management:

a) Project Manager(s): Jim W.S. Young
b) Service: EC/AES
c) Address: Downsview, Ontario
d) Phone Number: (416) 739-4995

5. Project Objective(s):

To archive the ERICA field phase data and to begin the scientific analysis.

6. Project Accomplishment(s):

Essentially all the data sets obtained during the field phase have been archived. The effort has benefited immensely from the data management effort of the Canadian Atlantic Storms Program. Analysis of soundings has already begun and a comparison between storms deepening over Atlantic Canada and over the Gulf Stream has been almost completed. Preliminary results have been discussed with operational forecasters.

7. Publications/Papers/Reports in 1989-90:

Environment Canada, (1989). *ERICA Field Phase Summary*, ERICA Data Centre, Drexel University, Philadelphia, PA 19104

Environment Canada, (1990). *ERICA Data User's Guide.*

8. Proposed PERD Resources: $150K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	98.10	51.90	0.00	0.00	0.00	150.00	0.00
EC	0.00	45.00	75.00	1.30	50.00	170.00	1.30
OTHERS: ONR & NSF[1]	0.00	1000.00	0.00	0.00	0.00	1,000.00	0.00
TOTAL	98.10	1,096.90	75.00	1.30	50.00	1,320.00	1.30

[1] Office of Naval Research and National Science Foundation.

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Prof. C. Lin, McGill University	Quebec	KM175-9-7741	4.50
Kel Research Corp.	Ontario	KM175-9-7435	30.00
Dr. J. Salmon	Ontario	KM171-9-7523	20.00
A. Madej	Ontario	KM175-9-7413	22.49
Dr. N. Donaldson	Ontario	KM175-9-7416	21.10
TOTAL CONTRACTS			48.09

1. Title: Operational Ice Modelling

2. Project #: 67158

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:
a) Project Manager(s): John C. Falkingham
b) Service: EC/AES
c) Address: Ice Centre
Ottawa, Ontario
d) Phone Number: (613) 996-4552

5. Project Objective(s):

a) Complete the implementation of a simple ocean model to improve the Regional Ice Model (RIM), as recommended in the RIM evaluation study. This work was deferred from 1987/88 and initiated in 1988/89 as described in last year's report.

b) Prepare a report identifying the standard verification statistics and procedures to be used and describing the results of a pilot study on Canada's east coast. Prepare a standard verification set for the Beaufort Sea.

6. Project Accomplishment(s):

A contract valued at $76.9K was let to ASA Consulting Ltd. to couple an existing east coast ocean model to the RIM in order to complete the objectives for 1987/88. This contract was funded by Environment Canada according to the terms of the payback agreement made in 1987 and the work was completed in February, 1990. Two reports were prepared and the model was installed on a computer at Environment Canada's Ice Centre for operational implementation.

7. Publications/Papers/Reports in 1989-90:

ASA Consulting Ltd., (1989). *A Coupled Ice Ocean Dynamical Model for Ice.*

ASA Consulting Ltd., (1989). *A Coupled Ice Ocean Dynamical Model for Ice - User's Guide.*

8. Proposed PERD Resources: $100K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	100.00	0.00	0.00	0.00	100.00	0.00
EC	0.00	0.00	6.60	0.11	0.00	6.60	0.11
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	100.00	6.60	0.11	0.00	106.60	0.11

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
ASA Consulting Ltd.	N.S.		76.90
TOTAL CONTRACTS			76.90

1. Title: East Coast Ice and Climate Change

2. Project #: 67164

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.1 - ENVIRONMENTAL FORECASTING

4. Project Management:

a) Project Manager(s):	Andrea Saulesleja	Ron D. Brown
b) Service:	EC/AES	EC/AES
c) Address:	Downsview, Ontario	Ottawa, Ontario
d) Phone Number:	(416) 739-4346	(613) 996-4488

5. Project Objective(s):

Scoping study to provide a state-of-the-art review of possible impacts of global climate change on east coast sea-ice and iceberg regimes over the next 50-100 years.

6. Project Accomplishment(s):

a) Contractor report completed April 1990.

b) Results presented at 1990 Canadian Meteorological and Oceanographic Society (CMOS) congress.

7. Publications/Papers/Reports in 1989-90:

Arctic Sciences, (1990). *Implications of Global Warming for Canadian East Coast Sea Ice and Iceberg Regime over the next 50-100 years*, CCC report.

Marko and al., (1990). *Implications of Global Warming for Canadian East Coast Sea-Ice and Iceberg Regimes over the next 50-100 Years*, Climate Change Digest Report, (in press).

8. Proposed PERD Resources: $30K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	30.00	0.00	0.00	0.00	0.00	30.00	0.00
EC	0.40	3.20	11.22	0.22	0.00	14.82	0.22
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	30.40	3.20	11.22	0.22	0.00	44.82	0.22

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Arctic Sciences Ltd.	B.C.		0.00
Dr. Roger Barry, University of Colorado	U.S.A.		0.00
TOTAL CONTRACTS			0.00

1. Title: Integrated Hydrocarbon Monitoring

2. Project #: 67237

3. **TASK** 6 - **OIL, GAS & ELECTRICITY**
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.2 - ENVIRONMENTAL IMPACTS

4. Project Management:
a) Project Manager(s): Roger J. Percy
b) Service: EC/C&P/Atlantic Region
c) Address: Dartmouth, Nova Scotia
d) Phone Number: (902) 426-2576

5. Project Objective(s):

a) To modify and expand a 64-channel Gated Diode Array Spectrometer developed by Environment Canada.

b) To produce a high-resolution range-gated fluoro-sensor, suitable for both detection and identification of marine pollutants on the surface and at depth, and for depth-resolved measurements of water temperature and chlorophyll concentrations.

6. Project Accomplishment(s):

a) In February, 1989, Department of Supply and Services approved in principle a Unsolicitated Proposal (DSS-UP) for $1 million dollars, however, the U.P. fund cut was enacted before a final contract could be drawn up. Environment Canada subsequently put together a more modest ($215K) package with funding support from ESSO, United States-Mineral Management Service (US-MMS) and the Department of Fisheries and Oceans.

b) Developed an instrument that allows the discrimination of oil both at the surface of the water and at discrete depths within the water column. This instrument can also detect phytoplankton at depth; these are unique capabilities with significant commercial potential.

7. Publications/Papers/Reports in 1989-90:

Barringer Research Ltd, (1990). *Monitoring of Plankton Productivity, Migration of Juvenile Salmon and Oil Pollution Using a Newly Developed Airborne Fluorescent Sensor*, report prepared for Environment Canada, DFO, US-MMS and PERD.

8. Proposed PERD Resources: $60K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	55.00	2.50	0.00	0.00	0.00	57.50	0.00
EC	55.00	0.00	11.88	0.22	0.00	66.88	0.22
OTHERS:							
DFO[1]	0.00	30.00	0.00	0.00	0.00	30.00	0.00
ESSO	0.00	20.00	10.80	0.20	0.00	30.80	0.20
US-MMS[2]	0.00	54.00	0.00	0.00	0.00	54.00	0.00
TOTAL	110.00	106.50	22.68	0.42	0.00	239.18	0.40

1 Department of Fisheries and Ocean
2 United States - Minerals Management Service

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Barringer Resources Ltd.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Organic Pollutants from Flare Stacks

2. Project #: 67239

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.2 - ENVIRONMENTAL IMPACTS

4. Project Management:
a) Project Manager(s): Barry Munson
b) Service: EC/C&P/Western and Northern Region
c) Address: Edmonton, Alberta
d) Phone Number: (403) 468-8034

5. Project Objective(s):

a) To update the literature database, developing a draft research program design.

b) To present a draft design to the Government/Industry Consultative Committee on Flaring (GICCOF) technical sub-committee for approval. The committee is chaired by Alberta Environment and membership includes Environment Canada, Environmental Research Advisory Committee and Canadian Petroleum Association.

c) To present a draft proposal to the Environmental Research Advisory Council committee of Canadian Petroleum Association, to solicit and ensure their involvement in the program.

d) To prepare of a final report which is to include the updated literature database and the final research program design.

6. Project Accomplishment(s):

The efficiency of flares in Alberta is of considerable concern where approximately 2.5 million tons of gases are flared annually from approximately 2500 flares by oil and gas industry alone (Reid et al., 1989). The main contributors to the totoal flared gases along with approximate amounts flared include sweet oil production batteries, acid gas plants and sulfur recovery gas plants. Considering only hydrocarbon gases as being flared and 100% combustion efficiency, approximately 7 million tons of CO_2 would be produced annually.

a) Completion of the research program design and submission to the GICCOF Technical Committee.

b) Completion of literature search on flaring practices employed by the petroleum industry in Alberta since 1976.

c) The Canadian Petroleum Agency's Environment Research Advisory Committee has supported the project in tems of the management of contract with the University of Calgary.

7. Publications/Papers/Reports in 1989-90:

Strosher, M., (1989). *Investigations of Flare Gas Emissions in Alberta: A Research Program Design.*

Strosher, M., (1990). *Flare Emissions and Control - A Literature Search of the Energy Database for the Period 1976 to 1989.*

8. Proposed PERD Resources: $100K

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	0.00	1.00	46.00	1.00	0.00	47.00	1.00
EC	5.00	8.00	20.00	0.33	0.00	33.00	0.33
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.00	9.00	66.00	1.33	0.00	80.00	1.33

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Mel Strosher, University of Calgary	Alberta		5.00
TOTAL CONTRACTS			5.00

1. Title: Treatment of Wastewater from Offshore Oil Production

2. Project #: 67245

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.2 - ENVIRONMENTAL IMPACTS

4. Project Management:
a) Project Manager(s): A. Zaidi
b) Department: EC/C&P
c) Address: Wastewater Technology Centre
Burlington, Ontario
d) Phone Number: (416) 336-4618

5. Project Objective(s):

a) Work with industry to evaluate the performance of hydrocyclones.
b) In-house evaluation of oil-in-water monitoring instruments.
c) Dissemination of information collected under the project during 1988/89.

6. Project Accomplishment(s):

a) A draft report was prepared to summarize results of the survey of the oil industry in the North Sea and was distributed to oil industry representatives for review.
b) A review of commercially available on-line oil-in-water monitors was conducted through a literature review and contacts with suppliers and users.
c) A technical steering committee composed of Canadian oil industry representatives was formed and met on a regular basis to provide input into the direction of the study.
d) Arrangements were made with Mr. Martin Thew of the University of Southampton for testing of the CSPI Vortoil static hydrocyclone under simulated Canadian offshore conditions. Similar arrangements were made with Serck Baker for testing of the Dynaclean rotary hydrocyclone.
e) Information was collected and summarized on the characteristics of Canadian crude oil from the Newfoundland, Scotia Shelf, Beaufort and Arctic regions.
f) Initial laboratory work was completed on oil and grease analytical protocols and an experimental program was developed for work in 1990/91.
g) Contacts with Canadian Navy and Coast Guard personnel have been established.

7. Publications/Papers/Reports in 89-90:

A draft copy of the monitor database assembled in 1989-90 has been circulated to the technical steering committee and to instrument manufacturers for review and comments.

8. Proposed PERD Resources: $56K (1.0 PY)

9. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	12.40	65.60	0.00	0.00	0.00	78.00	0.00
EC	0.00	53.00	13.20	0.22	0.00	66.20	0.22
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	12.40	118.60	13.20	0.22	0.00	144.20	0.22

10. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Ian Martin & Associates Ltd.	Ontario		0.00
TOTAL CONTRACTS			0.00

1. Title: Biodegradability of Base Oils and Associated Drilling Fluid Additives

2. Project #: 67246

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.2 - ENVIRONMENTAL IMPACTS

4. Project Management:

a) Project Manager(s):	Jim Osborne	Bob Baker
b) Service:	EC/C&P/Atlantic	EC/C&P
c) Address:	St. John's, Nfld.	Hull, Quebec
d) Phone Number:	(709) 772-4047	(819) 953-1693

5. Project Objective(s):

a) To complete analysis and prepare final report adapted for regulatory application.

b) Preparation of a practical method of evaluating the biodegradability of base oils and associated drilling fluids products.

6. Proposed PERD Resources: $25K

7. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	25.00	5.00	0.00	0.00	0.00	30.00	0.00
EC	0.00	0.00	11.88	0.22	0.00	11.88	0.22
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	25.00	5.00	11.88	0.22	0.00	41.88	0.22

8. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
CB Research International	B.C.	4852 KE145-6-0996	0.00
TOTAL CONTRACTS			0.00

1. Title: Pollution from the Offshore Oil Industry: Putting it into Perspective

2. Project #: 67267

3. TASK 6 - OIL, GAS & ELECTRICITY
PROGRAM 6.7 - ENVIRONMENT
SUBPROGRAM 6.7.2 - ENVIRONMENTAL IMPACTS

4. Project Management:
a) Project Manager(s): Jim A. Elliott (DFO)
b) Service: EC/OSA
c) Address: Bedford Institute of Oceanography
Dartmouth, Nova Scotia
d) Phone Number: (902) 426-8478

5. Project Objective(s):

a) To assemble the information available on the predicted inputs of oil from exploration on the Grand Banks and Scotian Shelf.
b) To assemble the information available on the inputs of oil and other contaminants from other users of the offshore environment.
c) To prepare a draft report.

6. Project Accomplishment(s):

a) Assembled available data on the predicted inputs of oil from exploration on the Grand Banks and Scotian Shelf.
b) Assembled available data on the inputs/impacts of other users.
c) Prepared a preliminary draft report.

7. Proposed PERD Resources: $50K

8. Resources Expended:

	O&M		SALARY & BENEFIT		CAPITAL	TOTAL	
	Contract	Other	$K	(PY)	$K	$K	(PY)
PERD	40.00	0.00	0.00	0.00	10.00	50.00	0.00
EC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHERS:	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	40.00	0.00	0.00	0.00	10.00	50.00	0.00

9. Contract Information:

CONTRACTOR	PROV.	CONTRACT #	AMOUNT $K
Belinda Wilkinson	N.S.		40.00
TOTAL CONTRACTS			40.00